THE MODERN PHYSICIAN

EDITED BY

DR. ANDREW WILSON

THE HUMAN SKULL AND INTERNAL ORGANS OF HEAD AND THROAT.

DRAWN FROM ACTUAL DISSECTIONS BY E. BURNET, B.A., London.

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45. Turbinated Bones.
46. Pharyngeal Tonsil.
47. Palatine Tonsil.
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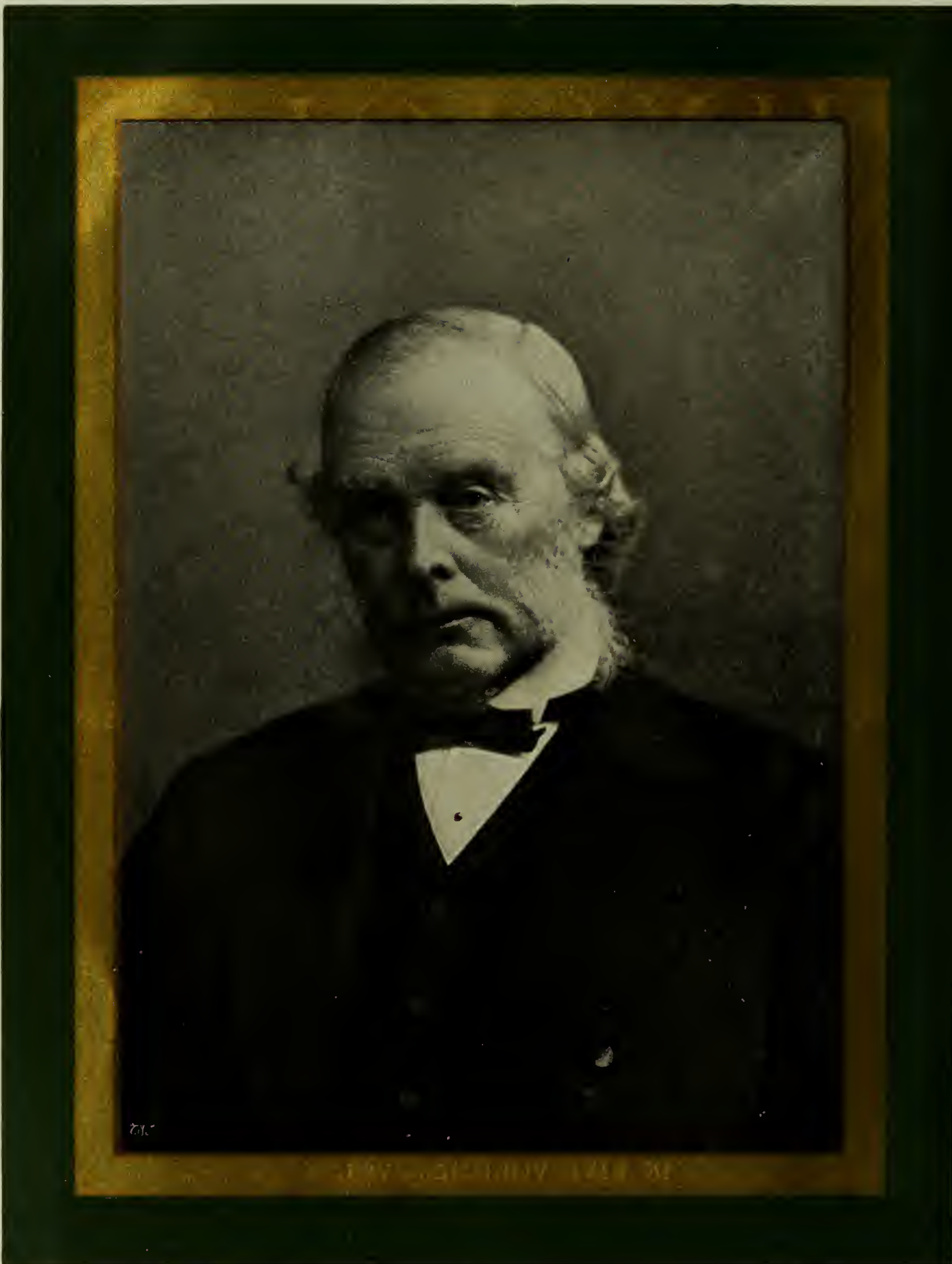
Wm Watson



LORD LISTER

Sergeant Surgeon-in-Ordinary to the King

Photo ELLIOTT & FRY, LONDON.

THE MODERN PHYSICIAN

BEING A COMPLETE GUIDE TO THE ATTAINMENT AND PRESERVATION OF HEALTH

Including Descriptions of the Causes, Symptoms, and Cure of Diseases and Ailments; the Structure and Functions of the Human Body ; Sick Nursing and Invalid Cookery ; Hygiene ; the Practice of the Laws of Health and Muscular Development ; the Family Medicine Chest ; the Care of Children and Infants ; the Health and Ailments of Women ; First Aid or Ambulance Work, etc. etc.

BY

DR. ANDREW WILSON, F.R.S.E., F.L.S., Etc.

LECTURER ON PHYSIOLOGY AND HEALTH TO THE GEORGE COMBE TRUST; GILCHRIST TRUST LECTURER ; FORMERLY EXAMINER IN THE FACULTY OF MEDICINE, UNIVERSITY OF GLASGOW; FOUNDER AND LATELY EDITOR OF "HEALTH."

AUTHOR OF "A MANUAL OF HEALTH SCIENCE," "COMMON ACCIDENTS AND HOW TO TREAT THEM," "MANUAL OF ZOOLOGY," "SCIENCE STORIES," "LIFE AND SENSE," "BRAIN AND NERVE," ETC. ETC.

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IN FIVE VOLUMES—VOL. I

LONDON
THE CAXTON PUBLISHING COMPANY
CLUN HOUSE, SURREY STREET, W.C.

PREFACE

This work is intended to present the reader with a scientifically correct but at the same time popularly written manual of domestic medicine. It also aims at imparting reliable information concerning hygiene or the due control of health through the knowledge of the laws which represent the practice of healthy living and the prevention of disease. Included in the subjects of this work will also be found Sick-nursing and Ambulance, with a variety of other topics bearing on the treatment of disease.

It has been the desire of all concerned in the production of "The Modern Physician" that the information conveyed in its pages should be thoroughly up to date, while its illustrations have been selected and executed with the view of rendering clear all notable points treated of in the text.

To those far removed from medical aid, and equally to those who desire to acquire an intelligent knowledge of the nature of disease and of the means adopted for its cure, this work may appeal. Knowledge of the kind found in its pages is essential for the intelligent advancement of the physical interests both of the individual and of the nation at large.

ANDREW WILSON.

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THE MODERN PHYSICIAN

SECTION I

INTRODUCTION

HEALTH AND DISEASE

What Health is and what Disease means.—Health may be defined as that condition in which all the actions and duties of life are perfectly and painlessly performed. When we talk about the painless performance of the functions of life, we indicate clearly the true nature of the state which is represented by the word "health." The healthy man, as a matter of fact, discharges all the duties of life in a painless manner. When pain appears upon the scene, another condition, that of *disease*, has to be reckoned with. If we divide the word thus, "dis-ease," we clearly see that it implies an absence of "ease," or, in plain language, a state of pain or discomfort. Discomfort is the first symptom of some bodily disorder. The highest aim of mankind is the attainment of happiness, and this aim cannot possibly be carried out save in the presence and possession of perfect health. It may be argued that the state of perfect health is somewhat rare, at least amongst civilised people; but we find much encouragement in endeavouring to attain to this ideal state in the experience of the past. The causes of disease are year by year being investigated, and with the knowledge of the causation of ailments, we arm ourselves in the matter of their prevention.

Disease Preventable.—A very important consideration connected with the advancement in respect of the repression of disease is found in the idea that many diseases are of a *preventable character*. A very excellent example of this important fact is found in the case of many of those diseases which we know as "fevers." For example, by a rigid attention to the purity of water supplies, and to the early separation and proper treatment of first cases, *cholera* has practically been banished from our islands. It is more than probable that within a relatively short period of time the same remark will hold

good of *typhoid fever*. Here we have a disease which is mostly contracted through polluted water. In such a case, the water has been contaminated by the germs of the disorder, which have bred and multiplied in the bodies of patients, and which, not having been disinfected owing to ignorance or carelessness, are allowed to mingle with the water-supply of a town or district. Therefore we may hold that if all cases of typhoid fever were rigidly attended to in the matter of disinfection, so that the germs of the disease were destroyed in every instance, we should be able to prevent this serious ailment in a very large measure, if not to abolish it altogether.

The Nature of Disease.—We have seen that whilst health means and implies the painless discharge of all the functions of life, "disease," on the other hand, is a condition associated with some disturbance of this ideal and typical state of the body. That there are many and various degrees of "disease" must be evident to the ordinary understanding, but a few examples will readily convince us of the fact that even a very slight departure from the standard of health may fall within the definition of disease. Thus a man with an aching tooth, due to tooth-decay, may be said to suffer from "disease," because he cannot discharge perfectly one duty of life, that of masticating his food. He is, in a minor degree at least, landed within the province of illness. Another person who has by accident broken his leg, may similarly be classified as a person suffering from disease. He cannot discharge an important function of life, that of locomotion or of moving about. If we take a third case of more serious character, we may suppose a man to have been infected with the germs of some serious malady. If he has been attacked by fever germs, we shall find that for weeks, it may be, he will exemplify a case in which all the functions of his body are more or less in abeyance. He, more typically than the other cases, exhibits what is meant by the state of disease as opposed to the state of health. His circulation, breathing, and other functions are more or less disordered, and until the disease has run its course, he cannot be said to illustrate the typical condition termed "health." It is naturally the aim of every reasonable person to attain to the highest degree of health possible. This aim can be attained first by paying special attention to the requirements of the body. These requirements include such conditions as pure food, pure water, fresh air, a healthy home, and also a knowledge of those conditions more especially connected with personal health, represented by attention to details of clothing, exercise, and other points closely connected with our daily life.

Science and Disease.—A knowledge of the laws of health

guiding a man towards the perfect regularity of his life in respect of the foregoing particulars, naturally makes, not merely for the preservation, but the continuance of the healthy state. A second point, however, involved in the cultivation of health is of equal importance to what may be called the personal supervision of our surroundings. This second point is represented by *a knowledge of the causes of disease.* It is knowledge of this kind which forewarns us, and therefore forearms us, against the attack of many of the ailments to which human flesh is heir.

The Case of Consumption.—An excellent example of this latter fact is found in the case of that general disease known as *tuberculosis*, an ailment liable to affect almost every organ of the body, and one which is more familiar to readers under the name of *consumption.* "Consumption" in other words is "tuberculosis," manifested by its attack on the lungs. Not so very long ago consumption was believed to be of hereditary nature—that is to say, a consumptive father or mother was regarded as being likely to hand on the ailment, and to transmit the disease to his or her children. The cause of the disease was then unknown. It was regarded, moreover, as an ailment difficult, and in many cases impossible, of cure.

Owing to the discovery of the germ or microbe of tuberculosis by Dr. Robert Koch, the whole complexion of this ailment was altered. In the first instance, with the knowledge of its exact cause, physicians became enabled to point out ways and means of prevention. In the second case, founding their practice on similar grounds, means of cure were tried and adopted, one of the most important of these being what is now known as the "open-air treatment." The discovery of the germ of tuberculosis has, therefore, had the effect of enabling us to attack and successfully fight this disease from two points of vantage. To-day the opinion is universally held that each case of consumption practically represents a case of infection; if infection be prevented, the disease can in this way be limited, or altogether abolished.

The chief source of infection in this ailment is undoubtedly represented by its germs, which are contained in the matter coughed up from the lungs of consumptive patients. If, as the case nowadays, the knowledge is widely circulated, that all matter derived from the lungs of patients should be perfectly disinfected and the germs killed, we can understand how consumption as a disease can be perfectly kept under control. That this knowledge is bearing fruit in a practical way is proved by the most recent statistics of the ailment. These show that in all cases where dealing with matter

coughed up from the lungs is duly taken in hand, the death-rate from tuberculosis is year by year decreasing. A second phase of matters shows us how a knowledge of the cause of disease leads us towards a clearer understanding of the conditions demanded for its cure by placing the consumptive patient in a pure atmosphere, where he breathes air uncontaminated by floating dust, and by attending properly to his nourishment. The body is so fortified that it no longer serves as a soil in which the germs of the ailment can breed and multiply. This illustration will serve to show how very exactly the art of preventing disease, and of curing it, follows upon one condition alone, namely, a knowledge of disease causation.

The Causes of Disease. — Recognising that disease implies some departure or other from that state in which all our bodily duties are painlessly performed, we have now to consider the important question of the *causes* to which the ailments affecting us are due. Most of these causes are of relatively simple nature, or at least of such a nature as may be readily enough understood. Physicians are accustomed to treat of the causes of diseases under two heads. The first of these includes what they term *predisposing* or *indirect* causes, that is to say, conditions which would not in themselves necessarily be capable of causing illness, but which may certainly contribute to the bringing about of ill-health. The second series of causes are those which medical men name *exciting* or *direct* causes. In dealing with the latter series of conditions, we come face to face with the actual material, so to speak, of disease. A simple illustration will show the difference between the two sets of causes to which allusion has just been made.

A person born of a weakly stock, and one whose progenitors have suffered from a disease such as *gout* or *scrofula*, need not necessarily be affected with these diseases by reason of his inheritance, but the physician, nevertheless, recognises that his ancestry must exert a certain influence in rendering him more likely to fall a victim to the attack of either ailment than a person would be who comes into the world with what may be termed a clean bill of health. The physician, in such a case, would regard the *inheritance* of the person as a *predisposing cause* of disease. On the other hand, with regard to "exciting" or "direct" causes, we find an excellent example of such a source of illness in the direct attack on the body by the germs of disease. A person who is exposed to infection, say by the germs of small-pox, scarlet fever, or typhoid fever, and who develops one of these ailments, illustrates the "exciting" cause, represented by direct germ-attack. In the same way one might legitimately

hold that an accident or an injury of some kind, involving a destruction of some part of the body, would also fall to be included within the category of the exciting causes of disease. So also, if a person accidentally swallowed some poisonous substance producing illness of a more or less severe kind, such a case would certainly be included in the latter category of causes.

We clearly see from these considerations that disease is no longer to be regarded as a mysterious something, the nature of which is ill understood, or not understood at all. The whole tendency of modern science in the prevention and treatment of disease is that of tracing every ailment to its exact source. If this most desirable knowledge is not yet wholly within our grasp, such a result may be regarded as due to the difficulties which beset investigation of this nature, but year by year research is being conducted into the causes of disease with increased success. As these words are written, for example, a very large amount of attention is being paid to the investigation of the cause of that most terrible scourge of modern life known as "cancer." The diseases included under this head appear to be singularly on the increase, and it may be readily seen that until their exact cause is ascertained we can entertain but little hope of the discovery of an effective cure. The case here is a parallel one to that already described in dealing with consumption and its prevention.

Old Views and New.—Of old, the nature of disease was naturally invested with a very large amount of superstitious surroundings. Diseases were frequently spoken of as "judgments," and were believed by many persons to represent the vengeance of Heaven upon human beings, and as punishments for sins committed. It is hardly necessary to point out that beliefs of this kind are not now entertained by intelligent persons. We must recognise, first, that if disease represents a judgment in any sense, it is one which nature inflicts upon us as a penalty for breaking some of those laws according to which the health of the individual and of the community is alike regulated. In this view of things nature is inexorable. If we do not ensure the purity of our food, of the water we drink, or of the air we breathe, we have only ourselves to blame if disease appears amongst us. The proper knowledge of the causes of disease, as has been shown, enables us to prevent disease, and therefore to avert what the ignorance of the past was pleased to term dispensations of Providence. In this light every practical mind will recognise that disease cannot be removed by prayers and fastings, but only by the adoption of those measures representing the laws of healthy living. Science demonstrates what is necessary in this respect of observance by us all.

Indirect Causes—Heredity.—Turning to more exact details regarding the causation of disease, we may, first of all, consider the question of *inheritance* or *heredity*. By this term is meant, of course, the legacy in the shape of our bodily constitution which has been handed down to us from our parents. This question of inheritance is an extremely important one, regarding which scientific opinion has changed very much within recent years. As has been previously shown, there was a tendency to regard a considerable number of diseases affecting the parent as being inevitably handed down to their offspring. The case of consumption may be again mentioned as an instance of this belief. The whole subject of *heredity* is of extremely complicated character. A man, for example, does not represent in himself a constitution derived from his father and mother alone, nor from his double series of grandparents only, but from a whole host of previous ancestors, the number of whom, extending backwards, must amount, in the case of each individual, to many thousands. Each of us may, therefore, be said to represent in himself or herself the concentrated essence of many constitutions. The elements which go to make up our bodies are not transmitted to us directly and in an absolutely unchanged condition from the beginning of things. On the contrary, in each generation, there can be little doubt the constitution becomes more or less modified. For example, a diseased stock may in time, by careful attention to the laws of health, be converted in subsequent generations into a healthy one. Conversely, a healthy stock subjected to unhealthy surroundings may develop a diseased constitution. Each of us as individuals may be regarded as the product of a literal process of evolution, which in some cases, modified by the environment, develops a healthy unit, and in other cases the reverse.

Health Culture.—With reference to the influence of heredity in producing disease, the general statement may suffice that our aim should be to cultivate in each generation the highest standard of health possible of attainment. Our great encouragement to this end is found in the interesting fact that a slight healthy improvement in one generation appears to be intensified in the next, and in this way a regular solid and cumulative advance in the physical condition of individuals and communities appears to be possible of attainment. A very celebrated sanitarian on one occasion remarked this fact in the following eloquent words:—

"The hygienic problem is how to free the English people from hereditary diseases—hereditary consumption, cancer, syphilis, gout; hereditary insanity, hereditary vagrancy, hereditary criminality, and to develop in the mass the athletic, intellectual, æsthetic, moral

and religious qualities which have already distinguished some of the breed. There is a divine image in the future, to which our nation must aspire. The first step towards it is to improve the health of the present generation; and improvement, if as persistently pursued as it is in the cultivation of inferior species, will be felt by their children and their children's children. A slight development for the better in each generation implies progress in a geometrical progression, which yields results in a definite time that if suddenly manifested would appear miraculous."

Soil and Seed.—With regard to the question of inheritance, it may further be remarked that many diseases formerly considered to be inevitably handed on from parent to offspring are now seen to represent an individual development rather than a hereditary origin. At the same time we must frankly recognise that, even if many diseases are not definitely transmitted from parent to children, there may at least exist on the part of the progeny of affected persons a tendency in their constitution which renders them more liable to the development of the ailments in question than the children of healthy parents. This question has been familiarly alluded to under the title of "The Soil and the Seed." If we suppose the body to represent the soil, and disease the seed which may be sown in the soil, we can clearly understand that whilst a given soil may not actually contain the germs or elements which are capable of springing into vitality, it may nevertheless offer a better and more likely field for their development than a soil of another kind. To take a concrete example: the child of a gouty family may not necessarily be born suffering from the disease itself, but may still possess a body which, subjected to unwise feeding and other unhealthy conditions, is much more likely to develop the disease than the body of a child coming from a non-gouty stock. At the same time it is extremely important for us to remember, that by due attention to the laws and conditions of health it is possible to render the soil (that is the body) less susceptible to attack, and as has been shown the improvement in one generation and the escape from disease represented in such a generation, will be transmitted with increased power to its successors.

Modern views of inheritance thus differ extremely from those entertained by the generations which have preceded us. It is perfectly true that "like begets like," but this phrase must be received subject to the modifications to which allusion has been made. Each individual practically exhibits in his development two forces or tendencies. One of these we may call "centripetal" or "centre-seeking." In virtue of this tendency we may suppose the offspring to follow more or less closely the lines of the parental constitution. The other

tendency we may call " centrifugal," that is, " flying from the centre." This latter phase may be said to represent the main idea of evolution, which causes the offspring to vary from the parent and to strike out new lines of development for itself. Each person may therefore be said, in the matter of health and disease, to be subjected to this double influence. If he is born of an unhealthy stock, and the conditions of his life are unfavourable, he will probably tend more or less to continue to represent the unhealthy state of his ancestors. If, contrariwise, his surroundings are favourable and his life regulated according to the laws of hygiene, we can see how new modifications will arise in his case tending to departure from the parental or diseased type, and towards the development of a sound constitution.

Other Causes. — Other predisposing causes of disease are represented by what may be called *personal conditions of life and existence*, or those proper to individuals, and also conditions which are represented by *external circumstances.* Thus the question of *age* is an important factor in considering the causes of disease. An excellent illustration of this fact is found in the case of that ailment known as *infantile diarrhœa.* It is a disease chiefly found in our large centres of population, occurs in the warm months of summer, and affects mostly infants under the age of one year. It attacks hand-fed infants especially, and is due to infection of the milk on which they are nourished. When the child has passed beyond the age of one year, it does not seem to be subject to an attack of this ailment in anything like the proportion exhibited at the earlier stage. Also in the case of children, we find a greater susceptibility to the attack of what are known as the ordinary fevers, represented by such diseases as scarlet fever, measles, whooping-cough, and the like. It is at the early period of life that bone troubles are most likely to occur. During the period when the bones are undergoing their development and formation a want of proper nourishment, or some other condition represented probably in the bodily history, may develop deformities especially in the bones of the lower limbs such as are familiarly known under the name of *rickets.*

Adult life also exhibits its own peculiarities in the way of disease tendency. Such diseases for example as gout, liver troubles, and kidney troubles, are of more frequent occurrence in middle life, as also are certain nervous troubles. *Old age* in its turn brings with it its own special risks of ailments. When the body and its tissues are examined in old age they are found to exhibit a natural process of decay, or what is more scientifically termed " degeneration." This may be considered to be a perfectly natural process, represent-

ing as it does the results of vital wear and tear. In old age we find a tendency for the fat of the body, for example, to be absorbed. When this takes place in the region of the face especially, we get the wrinkles of the old person. Similar changes take place in other portions of the body as the result of advancing years. The bones lose so much of their living substance and their gelatin, and tend to become more brittle. The muscles also tend to undergo what is known as fatty degeneration, the arteries or blood-vessels show a development of limy matter in their walls, rendering them less elastic and therefore less fitted perfectly to carry blood to the tissues; hence it is that in old people we frequently see the arteries, especially of the sides of the forehead, much more clearly defined than in earlier life. Each period of our existence is therefore marked by its own special risks of disease, and in this way *age* has to be reckoned with as one of the predisposing or indirect causes of the ailments to which we are subject.

Sex and Disease.—A few words on the question of *sex* must be included in the consideration of this mode of disease causation. Certain ailments are of course peculiar to women, and a considerable amount of risk of disease is necessarily induced by the condition of childbearing. But the domestic life of woman renders her probably less subject to a considerable number of ailments to which men are liable. The risk of accident is greater in the male than in the female sex, whilst it is notable that such diseases as gout, diabetes, and many lung troubles are more frequently seen in males. The life of a man, exposed as he is to a greater variety of conditions in the way of chill, cold, &c., necessarily presents greater chance of the acquirement of certain maladies. Taken as a whole, it may be said also the diseases due to excesses in the matter of foods and drinks are much less typically represented in women than in men. An excellent example of sex influence in disease is found in a stomach-trouble, extremely common in young women of *anæmic* or *bloodless type.* The typical subject of this disease in question is probably a domestic servant who has been somewhat overworked, badly fed, and has developed thereby general weakness of constitution. The disease in question is termed *ulcer of the stomach*, and consists typically of a sore which forms in the lining membrane of the stomach, causing pain just after food has been taken, and also producing a certain disturbance of the constitution at large. This disease is by no means common in men, and is possibly connected with the low state of health in women acting specifically upon the stomach and inducing a species of inflammation of which the ulcer is the direct result.

Another extremely common illustration of the sex influence may

be found in the case of *cancer*. Women undoubtedly are more subject to cancerous attack than men, the higher development of the disease in them being represented in the breast, womb, and other organs. The sexual differences represented between man and woman in such a case would appear to be of the highest importance in determining attack from the scourge just mentioned.

Influence of Climate.—There can be little doubt that amongst the predisposing causes of ailments *climate* must also be taken into account. The exact position on the earth's surface occupied by individuals or nations implies a certain risk of special diseases on the one hand, or escape and immunity from disease on the other. By way of illustrating this point we may select the case of *yellow fever*. It need hardly be remarked that the presence of this disease is largely a matter of climate or temperature. The microbe or germ of this disease does not appear to be capable of flourishing in the temperate zone, but amidst tropical surroundings it multiplies and grows readily, and therefore attacks those members of the human race who happen to reside in tropical areas. The case of *malaria* will also occur as an illustration of an ailment to a certain extent dependent on climate. We know now that *malarial fever* is conveyed by the bite of the mosquito, and it is therefore only in countries where these insects breed and multiply freely that malarial fever is likely to be acquired.

There is little doubt that climate, regarded in a broader sense, exercises a very prominent and potent effect in modifying disease. Taken as a whole, diseases which are due to poisons of one kind or another may be regarded as exhibiting a more severe type in warm climates than in colder regions. It is known, for example, that cholera, happily banished from our shores by attention to health matters, is of much more severe type in warm regions than it is in the temperate zone. The same is true of other ailments, and it is not unnatural to suppose that if many diseases be due to the attack of germs, which are living particles, the influence of these germs on the body must be largely regulated and modified by conditions represented in one word, by *climate*. In the temperate zone there is probably a greater liability to disease arising from cold and chill. Such diseases are represented not merely by lung troubles, but also by rheumatism and like ailments.

Season and Disease.—In connection with the subject of climate as a cause of disease, there falls to be mentioned certain curious facts concerning the relation of disease to particular seasons of the year. In other words, it appears to be provable that diseases, especially of an epidemic character, represented by the prominent

fevers, exhibit what may be termed *seasonable variations* in their development. It is found that at certain periods of each year, or in certain months, each disease shows what may be called a maximum degree of development, compared with an average or minimum degree of development in other months. This subject has been popularly termed the relationship of weather and health, and this latter designation very clearly indicates the general trend of the topic. It is evident, when the public health is considered, that if a given disease is found to be more prevalent at one period of the year than at another, a greater risk is thereby entailed in the matter of the public welfare, inasmuch as there must exist larger chances of infection.

Researches, on which the chief conclusions arrived at by sanitarians have been founded, were undertaken by Sir Arthur Mitchell, K.C.B., M.D., and Dr. Alexander Buchan, the famous meteorologist. Taking the statistics of each disease with respect to its yearly development, they constructed a series of graphic diagrams. Each diagram has for its basis a straight line (Fig. 1). This line may be taken to represent the average or mean development of the disease, that is to say, the occurrence of the ailment when represented neither by an excess nor by a minimum of cases. This straight line is divided into twelve spaces corresponding with the months of the year. If now the prevalence of a disease be noted through a series of years, it is possible, by the use of another line, which will rise above or fall below the straight line, to show the periods of the year at which the disease is most prevalent.

Small-Pox.—Certain prominent results obtained by this method of investigation yield very interesting facts. Beginning with *small-pox*, it is found that this disease is far more prevalent from January to the end of June than in the latter six months of the year. Epidemics of small-pox may therefore be expected to occur more frequently during the first six months than in the later months.

Scarlet Fever.—Looking at a diagram of scarlet fever we appear to find a disease which in respect of its seasonable development presents a distinct opposite to the case of small-pox. Scarlet fever in Britain seems to attain its highest development from September to December. From January to July this fever falls below the average, but in New York scarlet fever in its seasonable development appears to resemble small-pox as the latter disease is developed in Britain. In New York the highest period of small-pox development is from January to June, whilst its lowest exists from June to November. In December it begins to show an increase, leading onwards to the beginning of the next year.

Whooping-Cough.—With regard to *whooping-cough,* this disease is present with us mostly from January onwards to May. In the latter month it begins to decline. From July to December the curve falls below the line, showing, therefore, a minimum degree of development.

Typhus.—*Typhus fever* shows, on the other hand, a very curious set of curves: the line representing its seasonable development passes above and below the straight line in a manner which may be described as decidedly irregular. A series of curves rises high from January to the end of April, another rise takes place in July, and yet another in October. The general story told us regarding typhus fever (which is a disease of the slums occurring amongst the poor, the dirty, and especially the overcrowded) is that its high development in the earlier months of each year is probably due to the fact that at that period there is likely not only to be more overcrowding, but also a greater prevalence of poverty.

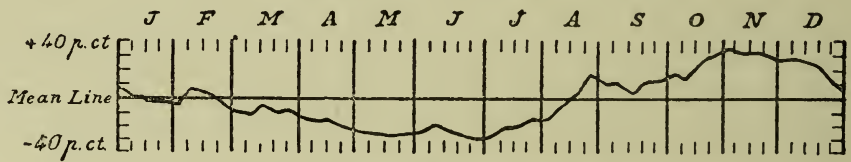


FIG. I.—The Curve of Typhoid Fever (Mitchell and Buchan).

The spaces indicate the months from January to December, the straight line representing the mean or average development of the disease.

Typhoid Fever.—With regard to *typhoid fever*, a very different disease (otherwise known as *enteric fever*), we find this ailment to be emphatically one of the autumn season. In America it receives the common name of *Fall fever* from this circumstance. The curve here begins to rise at the end of August (Fig. 1). It keeps above the straight line to the end of the year, when it begins to fall. During the earlier part of the year the line of typhoid development may be said to keep near the mean or average. All experience of typhoid attacks confirm what these researches show in the graphic method just described. It is from the end of August onwards towards the close of November that we experience the greatest liability to attack.

The Causes of the Variations.—If inquiry be made regarding the reason for these peculiar developments of different diseases, we may, in the present state of our knowledge, refer the solution of this question to differences in the life history of the microbes or germs to which the ailments in question are due.

It is highly probable that conditions of climate involved in temperature, wetness, dryness, and resulting conditions of soil, may

affect the development of the microbes to which such ailments owe their origin, and in the case of conditions favourable to their rapid multiplying, such influence must entail at particular seasons a greater risk of infection.

Infantile Diarrhœa.—We also find an additional illustration of the influence of season in developing disease in the case of that ailment known as *infantile diarrhœa.* As has already been noted, this disease affects children chiefly under one year of age, and its germs are conveyed to these infants in polluted or contaminated milk. Especially a disease of our large centres of population, this ailment in its symptoms and progress may be described as really a kind of cholera, producing very rapidly serious, and often fatal effects. With reference to the development of the disease, it has caused in the past a mortality of over 25 per 1000 births. The curve, founded upon records of many years for London, shows that the mortality from *diarrhœa* rises in June, continues to ascend in July, and apparently attains its highest level about the beginning of August. From this point the curve rapidly descends. We here find that the mortality from this disease, and indeed its occurrence both in infants and adults, corresponds with a rise in temperature—no doubt affecting the milk on which children are fed—although probably other conditions, especially that of soil and sub-soil water, may have a certain amount of influence in causing either an increase or decrease of the ailment.

Our Daily Life.—Another set of "predisposing causes" of disease are those which may be summed up in the general expression, conditions of daily life. Under this head *personal habits* fall to be included. Here we touch upon a very wide subject of the relations of human beings to their environment or their surroundings. Man closely resembles lower animals in respect of the fact, that whilst he may be able to render himself somewhat independent of his surroundings, he is nevertheless largely affected by them. When we take into consideration the fact that civilisation, so far from always being synonymous with health, brings about or induces conditions which are sometimes in themselves opposed to healthy living, we may readily understand the influence of the environment as affecting the health both of the unit and of the community.

Slum Life.—In our great centres of population there are many conditions represented which are decidedly the reverse of healthy. There we have much overcrowding present, and this condition, associated as it often is with poverty, intemperance, and dirt, is undoubtedly productive of much disease. It is impossible to think of children being brought up in a healthy and satisfactory fashion

amidst the environment in question, and we can readily note how a very large amount of absolute degeneration of body and mind must take place in the slums of our great centres. That this degeneration is a very real matter, producing weakly bodies and vicious minds, is only too thoroughly proved by recent investigations made into the condition of the masses. The mere fact that large numbers of would-be recruits drawn from the masses are rejected by Army medical officers as being unfitted for ordinary military service, tells its own tale—that of physical and mental decay—and testifies to the degrading influences of the slums.

Another important consideration which the social philosopher and sanitarian cannot afford to leave out of consideration is one connected once again with the question of *heredity.* In the masses we have almost universally exhibited a condition which undoubtedly makes for race degeneration more quickly than any other. This is the matter of *unwise marriages.* Unions are common not merely amongst persons too young to marry, but between those who are physically unfitted for marriage. The result is that we find that the progeny of such unions are born into the world as a kind of damaged stock in a physical sense, and statistics appear to prove that a town-bred and slum-bred race tends to be wiped out of existence in from three to four generations. In other words it succumbs to its own degenerateness, the direct result of the unwise policy thus represented. It has been well remarked apropos of this subject, that if one-tenth part of the attention which is devoted to the breeding of horses, cattle, sheep, dogs, and even pigeons, were bestowed upon the human race itself, we should avert a very large amount of preventable disease, and also arrest the process of degeneration, which cannot be regarded as anything less than a serious menace to the prosperity of any nation.

Occupation and Disease.—Amongst other conditions connected with the social existence of the people such as are capable of indirectly influencing disease production we must take into account the matter of *occupation.* It is undeniable that a very considerable number of diseases are induced by the conditions under which men and women are compelled to earn their daily bread. Before the invention of improved methods of manufacturing lucifer matches, phosphorus poisoning was extremely common amongst employés in match factories. This particular form of poisoning mostly assumed the character of what is known as "*phossy jaw.*" The fumes of the phosphorus acting on the jawbone, and usually affecting the bone by reason of teeth decay, produced death of the bone, or *necrosis,* as the ailment is termed by medical men. Now, however, this disease

is rarely seen, owing, as has been remarked, to improvements effected in the mode of match manufacture, and also to legislation and other conditions protecting the health and physical welfare of the workers. We see in this instance of what is called an *industrial disease*, one capable of being abolished through knowledge of its cause, and through avoidance of the conditions which tend to produce it.

There are many other employments which decidedly conduce to disease of a special kind. The "grinders" of Sheffield employed in grinding articles varying from needles and knives to scissors and scythes are specially subject to lung troubles, produced by their breathing air highly charged with the minute particles of metal given off from the objects with which they deal. Similarly, workers in white lead factories are subject to poisoning through this substance, but it has been shown that if ordinary care be exercised in connection with the cleanliness of their persons, their risks may be reduced to a minimum or altogether avoided.

Coal miners were formerly subject to lung troubles induced by the breathing in of coal dust. Thanks to the better ventilation of mines this disease has been enormously reduced, and the health of the coal miner of to-day may be described as being of a fairly satisfactory character in so far as risks of disease attendant on his work are concerned.

These remarks may serve to illustrate in a general way the influence of trades or professions on health. It may indeed be said that there are few occupations which do not exhibit a certain amount of risk in the way of disease-production. Some, however, are extremely free from such risk, whilst others stand at the opposite end of the scale in this sense. Each occupation has to be considered in this particular aspect on its own merits.

Our Environment.—In so far as the surroundings of human beings are concerned, we may sum up the requirements for health under the headings of pure food, pure water, pure air, and pure dwelling-places. Put in another fashion, we may state the truth by saying that the essence of all health, and one might add of all medical science in its dealing with disease, may be included in the one word, *Cleanliness.* The term *cleanliness*, therefore, might be regarded as a kind of motto we might inscribe over the portals of any temple of health. Conversely, we may say that *Dirt* of one kind or another is the fertile cause of disease. If the food of the community be not pure, free from taint, of a proper quality, and taken in proper quantities, disease is liable to be produced. The same may be said, but in stronger terms, of the water supply; for a water polluted with diseased material is liable not merely to affect us as

individuals, but as communities at large. The breathing of a pure atmosphere is another essential condition for a healthy existence. The construction of open spaces in all our great centres of population, ensuring a proper circulation of air, may be regarded as a feature deserving of more practical illustration than is usually accorded to it.

The House and Disease.—That the *house* may be indirectly a source of disease, or sometimes may prove itself a very direct source of illness, may easily be shown. When the drainage of our houses becomes defective, we are then liable to have sewage gases passing within our dwellings. It may still be an open question whether the presence of sewage gas may directly infect us with such a disease as typhoid fever or diphtheria, but, at the very least, the breathing of an impure atmosphere of this kind, and the living in houses of which the drainage is defective, undoubtedly produce a lowered condition of the body, rendering us much more susceptible to the attack of illness. Hence the importance of recognising the dwelling-place and its sanitary arrangements as important factors in determining our health.

Preventive Medicine.—What is known as *preventive medicine*, or in other words the practical application of the laws of health to the prevention of disease, is happily now largely represented in those enactments which have been framed for the due regulation of the public health. A very large amount of good has been effected by the institution of such regulations, especially with reference to the proper drainage of towns and cities, and to the disposal of the sewage and refuse inseparable from the presence of large communities. We may therefore hope that as public sentiment becomes better educated with reference to the effect of such regulations on the health of a community, a greater advance in the matter of our physical welfare will not merely be made possible, but will be found to be actually attained by the nation.

Our Personal Health—Alcohol.—Amongst our *personal habits* must be reckoned certain other important cases of disease of the predisposing or indirect nature we are considering. Undoubtedly one of the most baneful habits which can affect the human race is that of *intemperance*. Under this term we include excessive indulgence in alcohol. It is not necessary at present to discuss the important question of the action of alcohol on the healthy body, for that topic may well be left for consideration when dealing with the subject of our foods and drinks. What is of importance in connection with the causation of disease is a clear knowledge of the fact that intemperance is responsible not merely for a vast amount of

disease actually induced thereby, but is likewise indirectly responsible for the bringing about of degeneration of the body, while it also acts in the production of insanity and crime. This indictment against the excessive use of alcohol, although formidable, is perfectly just. The medical profession have long recognised this fact, and it is not, therefore, wonderful to note that the physician finds himself bound to lend his countenance and support to all agencies which have for their object the repression of drunkenness and the better appreciation by the people of the dangers involved in the excessive use of alcohol. It is thus impossible to overlook the subject of the *alcoholic habit* as a factor in the production of disease. It will be understood that here we are dealing with the excessive use of alcohol — in other words, with its abuse. The effects of over-indulgence in alcohol no doubt vary with the individual constitution, but there are certain common effects which accrue from alcoholism familiar to all physicians as leading to certain definite results in the way of disease production.

The general effect of over-indulgence in alcohol is to produce widespread degeneration in the tissues of the body. The proper nutrition of the body is interfered with and disease thereby induced. Amongst more exact effects of alcoholism may be mentioned the liability of the drunkard to brain and nervous disorders, whilst a well-known effect is also produced on the liver. This organ in the victim of alcoholism exhibits a very marked alteration in its structure, and therefore in its functions also. What is known respectively as "drunkard's liver," "gin drinker's liver," and "hobnailed liver" represents the condition to which reference has been made. The effects produced on the moral character of the individual given to alcoholism excess need not be referred to here. Suffice it to say that the unstable condition of the brain produced by such excess is one leading to grave alterations in conduct, such as in too many cases bring the victim of this habit into the sphere of the criminal.

It is not necessary to make reference here specially to other habits connected with the abuse of foods, seeing that the diseases induced thereby will be duly treated of under their respective heads. We may only refer here to *corpulence* or *excessive stoutness* (*obesity*) as a disease frequently resulting from errors in diet, whilst an allusion may be made to the fact that such diseases as *gout*, *rheumatism*, and *diabetes*, if not actually caused by some error in food-taking, are at least capable of being modified or cured by the adoption of a proper dietary.

The ill-regulation of life in other matters, such as the want of sleep, the abuse of tobacco, tight lacing in women, want of exercise, and the like must be taken into account in the consideration

of the indirect causes of disease. One can readily understand that where any habit can be shown to be inconsistent with the development of a healthy body and with its proper regulation as directed by the science of hygiene, disease is liable to be produced.

Our Personal Equation.—In thus discussing the predisposing or indirect causes which lead to disease, we have practically come upon nothing lying outside the common order of the surroundings of our daily lives. The barrier line between a cause which only predisposes to disease and one which is the actual cause thereof, we have admitted sometimes to be very finely drawn or absent altogether. The one kind of source or cause in certain points may overlap the other series to which we shall presently direct attention. In concluding this particular subject, however, it is necessary to refer to a very important condition in connection with the causation of all diseases, viz., what may be called our *personal equation.* It may well be held that no two persons are exactly alike in respect of their physical constitution. The differences in this respect exhibited by two individuals, even children of the same parents, may be very great. Naturally it is still more distinctly marked in the case of those who are not connected by any ties of blood relationship whatever. It is highly important, therefore, to note that each of us is a law unto himself or herself not merely in the matter of health, but as regards all the conditions which make for health or which are capable of producing disease. If we suppose, for example, that a certain number of persons are exposed to infection of any kind, the chances are that whilst a certain number may be attacked, a certain proportion will escape. Why some should thus be more fortunate than others is difficult to explain, and is a matter which possibly can only be accounted for on the general principle that constitutions vary, and that in virtue of this variation escape from attack is possible in one case and impossible in another. Hence, what we have termed the *personal equation* is a very important factor in the life of each individual in respect of likelihood of acquiring certain diseases and the prospect of escape from others. Doubtless, as we have shown, a personal bias is given to each of us from the side of inheritance. At the same time, it is not always easy to determine in what direction our special health dangers lie. Probably if the science of health were more carefully cultivated than is the case to-day, each individual would be charged with the duty of ascertaining as far as possible the special lines of weakness and strength in his constitution. In this way we might be able, to a certain extent at least, to guard ourselves against disease attack, and to ensure a greater freedom from illness than is the case amongst us to-day.

An Illustration.—A practical application of these remarks might be readily found in a very simple and common occurrence of life. It is a recognisable fact that chill and cold are productive of certain very definite results, but a chill does not affect all individuals alike, nor will it affect the same individual similarly in every case. We may suppose that the chill which gives one nothing more than a simple cold in the head may give another an attack of pleurisy. In the case of a third the chill may produce rheumatism; and in the case of a fourth, inflammation of the lungs. A fifth may be attacked by bronchitis, while a sixth may escape all ill effects whatever. The case of a cold parallels that of infection from fevers. If we suppose twenty persons to drink water containing the germs of typhoid fever, it is extremely improbable that all of them would be attacked; a certain proportion might be expected to escape infection altogether. This fact was well illustrated during the siege of Ladysmith, when only a certain proportion of the besieged were attacked, all drinking from the same water-supply. The question, therefore, of our individual liability to disease attack is therefore a highly important one in view of the different effects liable to be produced.

The practical lesson representing the outcome of these remarks is found in the advice, that if each of us may be said to have a weak point or points in our constitution, it is our bounden duty to ourselves to discover the special nature of the weakness in question. It is philosophy of the soundest kind which teaches us that the knowledge of such weak points, practically applied, would enable us, if not to avert disease altogether, at least very largely to diminish our chances of attack.

The Exciting or Direct Causes of Disease.—We now proceed to the consideration of those sources of disease which, as already explained, act upon the body in directly producing injurious effects. This they may do of themselves or in conjunction with those causes and conditions of body alluded to under the head of "predisposing causes."

Climate.—The influence of *climate* falls to be considered in the light of a direct cause of ailments in respect of the effects which *cold* and *heat* may respectively produce on our bodily functions. There can be little doubt that *cold* is of the two causes that which has to be most frequently considered. To a lowered temperature may be ascribed a very large number of diseases of common occurrence; troubles which vary in importance from a slight cold onwards to *bronchitis* and to a far more serious trouble such as *inflammation of the lungs* or *pneumonia*. It may be difficult to account for the mechanism, so to speak, through which such effects are produced,

but it is probable that in the first instance the circulation of the blood is affected, especially in the skin tissues, the surface of the body being naturally that most exposed to the influence of chill. Through this action producing alteration of the circulation and of the conditions under which the body and its tissues are nourished, a secondary influence is no doubt transmitted through the nervous system to other parts and regions of the body. In this way a chill primarily affecting the skin may produce the simple cold or the more serious lung trouble. Affections of the breathing organs are not the only ones which we owe to the existence of this sudden or continued lowering of the body's temperature. Rheumatism may be mentioned as a disease which arises, in the way of an exciting cause, from chill and from dampness at large. The influence of a damp soil on rheumatic persons, and even of a wet season, is thoroughly well understood by medical men.

A Damp Soil.—It may be added here that in the same way the marked effect in the lowering of the bodily health by a damp soil is also illustrated in the case of consumption. The death-rate from this disease is known to decrease according to the dryness of the soil produced by proper drainage. Buchanan in this country and Bowditch in America long ago showed that the death-rate from consumption has a most distinct and direct relation to the dampness of the soil, due to the presence of what is called *subsoil water*. When this water was disposed of and the soil dried by proper drainage, the death-rate from consumption in both English and American towns was found to diminish by as much as 30 and in some cases 50 per cent. We see, therefore, that cold and damp act as direct agents in producing most lung troubles, whilst neuralgia is another complaint very directly influenced, as a matter of causation, by cold and also by the condition of dampness.

Heat and Disease.—When we turn to the opposite condition of heat, we find a more limited range of disease induced by this condition. One's thoughts naturally turn to *sunstroke*, or, as it may be more properly termed, *heat stroke*, as an example of an ailment directly induced by an excessive temperature. This ailment occurs when, in the presence of extreme heat, the body is prevented from one cause or another from duly and properly regulating its temperature. We are not surprised to find that this ailment occurs, not merely in the direct presence of the sun's rays, but is also found to happen in the stoke-holes of steamships, amongst soldiers on the march, and under other circumstances where the relation between the body and the outside temperature is altered and disturbed.

Infection.—Another and different series of direct causes of diseases are found in the shape of conditions that may conveniently be summed up under the general term of *infection.* Here we enter upon an extremely wide field, the consideration of which will be separately dealt with in a subsequent section of this work. The most common source of infection is that which takes place by means of the microbes or germs to which a large number of diseases owe their origin. In the section on *Bacteriology* the nature and general history of the chief varieties of microbes will be duly discussed. It may suffice here, however, to point out that infection by these microscopic enemies of ours represents the direct causation of disease in a very typical fashion.

When a man swallows the germs of *typhoid fever*, when he inhales those of *small-pox* or *typhus fever*, or when, through a wound, he is inoculated with the germs of *tetanus* or *lock-jaw*, he exemplifies in the clearest fashion the influence of infection as the exciting and direct cause of each disease just named. There can be little doubt that a very large amount of sickness, to say nothing of a heavy death-rate, are caused by diseases which owe their origin to such direct infection. One of the most important lessons taught us by the science of health is that we possess a certain definite power of preventing such a mode of attack, through efficient disinfection, whilst we possess certain other means of prevention in the shape of vaccination against small-pox, and also through the use of certain cultures of germs by way of rendering the body immune, through inoculation, to the attack of the specific microbes to which such diseases are due.

Parasites.—In connection with the subject of direct infection, we may also take into account the question of diseases which are the result of an attack upon the body of *parasites* of various kinds. A parasite may be described as an animal plant which lives in, or upon, and usually at the expense of another animal or plant. Some plants are parasitic upon other plants, and cause actual disease of the trees or shrubs, to which they stand in the relation of unbidden and unwelcome guests. The mistletoe may be selected as an example of a parasitic plant, which draws so much of its sustenance from the tree to which it attaches itself. Diseases of plants, of which *dry rot* is an example, are also caused by one kind of plant, the parasite, attacking another, and often a higher species.

Plant parasites, however, may also attack animals. A very considerable number of skin diseases in man and animals is due to the direct action and growth of miscroscopic plants. *Ringworm* may be selected as a familiar instance of a skin ailment due directly to the

growth and multiplication in the skin of a low species of plant life of the fungus order. Animal parasites in their turn infect their neighbours, and are capable of producing disease sometimes of a serious nature. A tape-worm living in the human intestine or bowel will give rise to certain definite symptoms, whilst a more serious parasite is that known as the *trichina worm.* This last is obtained from diseased pork, and is capable of inducing very serious results in man. Fatal cases caused by the presence of this parasite have been frequently observed, and in some instances actual epidemics have been recorded.

Bodily Poisons.—Closely connected with the subject of infection by microbes, and likewise with that of disease caused by parasites, is the subject of ailments which owe their origin to the presence in the body of certain principles or *poisons,* to which the name of *toxins* may be generally applied. If we enumerated the cases in question as due to the poisoning of the tissues, we should probably indicate correctly enough the general idea underlying this species of disease causation.

It may be said, in fact, that germs which affect our body injuriously produce their effects, not so much through their own growth and multiplication in our tissues, as through the influence of the toxins or poisons to which they give origin. Therefore infection, already discussed, might in another sense be regarded as a form of body-poisoning. In a disease such as *diphtheria* the toxin directly affects the body at the outset of the ailment, and passes later on to the nervous centres. The same fact is no doubt true of that common ailment, *influenza.* The often serious after-effects seen in the latter ailment, the affections of the nervous system, heart, lungs, or digestive organs that are apt to supervene after an attack, are no doubt due to the fact that the poison produced by the influenza germs selects one or other organ for attack, and thus brings about results which are often in their way more serious than the actual disease itself.

Animal Poisons.—There are poisons, however, of other kinds capable of producing serious results on the human body. The bite of a poisonous snake, for example, inoculates the frame with a poison of extreme virulence, capable of producing death within a very short space of time. Another equally telling illustration of the power of poison as a direct cause of disease is seen in the case of that ailment known as *hydrophobia.* This disease, as is well known, arises from the bite of a dog which has suffered from *rabies* or *canine madness.* There is developed in the *saliva* (or water of the dog's mouth) a highly poisonous principle. If this substance be inoculated

into the body through the bite of the animal, we find direct effects produced sooner or later, the special poisonous principle ultimately attacking the nervous system, and in a fatal case producing its effect through the convulsions that affect the nervous centres.

Another phase of this question of disease production through the influence of poisonous principles may be finally alluded to under the heading of poisonous substances which are generated in the body itself as the result of some derangement of its functions. An excellent illustration of this latter variety of disease is afforded by the case of many kidney troubles. In such an ailment as *Bright's Disease*, for example, we find *albumen* to be passed with the urine. This albumen practically represents certain principles contained in our food, which from one cause and another cannot be properly used up in the body, the result being that we find serious results induced, not merely in the case of the kidneys themselves, but upon other and distant organs of the frame. Yet another illustration may be drawn from the region of the kidneys. If, for example, a certain principle called *urea*, which in health is removed from the blood by the kidneys, is allowed from one cause or another to pass back into the circulation, it acts as a poison of extreme power. What are known as *uræmic convulsions* and allied troubles arise from this particular source. In the same way we may regard under this head of disease produced by poisoning, the special substances to which we owe *rheumatism* and *gout*. Rheumatism is produced by an excess of a particular acid (*lactic acid*) in the blood, the body apparently being unable to fully dispose of this acid or to perfectly utilise certain foods from which this acid is formed. In the case of gout we note another acid (*uric acid*), which is generated in the body, to act as the particular poison. Poisonous foods also are capable of inducing disease. The most frequent illustrations of this latter class of ailments are derived from cases where, owing to foods having been allowed to undergo decomposition, virulent principles called *ptomaines* are developed. These are capable not merely of inducing severe illness, but of causing death.

Accidents and Injuries.—Finally, we must take into consideration the sources of disease which are represented by *injuries* and *accidents* of all kinds, ranging from burning and scalding, onwards to bleeding, drowning, the breakage of bones, and the accidental swallowing of poisons themselves. The treatment of this special class of injuries, in so far as the public are concerned, is carried out through a knowledge of the principles of *ambulance* or *first aid teaching*. A special section of this work will deal with this important topic in full detail.

THE SYMPTOMS OF DISEASE

Dealing with this subject in a general fashion, we may nevertheless be able to appreciate its extreme importance. On the recognition of the particular symptoms exhibited by any special ailment or disorder the physician's power and opportunity of successfully treating an ailment naturally depends. Knowing the general characteristics of the body and its functions in health, we are able to discern in disease more or less distinct evidences of departure from those actions which the healthy body exhibits. Disease itself we have seen to represent essentially a departure from what may be called the normal or natural type of bodily action, or bodily structure, or both.

It is necessary here to remark that as regards disease, a very broad but important distinction must be drawn between two classes of diseases, and therefore between the symptoms, appearances, or features which these classes present to view.

In the first instance disease may be associated with alterations of the actual structure of the tissues or substance of the body. This is what we term *organic disease*, that is to say, there is some definite change in the structure of the organ or part affected. The liver of a drunkard which exhibits a "hobnailed" appearance forms an excellent illustration of what is meant by disease of an organic nature. The whole structure of the organ is practically affected, and the ailments which result directly depend upon the inability of the organ to perform its work. A heart which has certain of its valves affected so that the blood-current cannot be properly regulated, or a heart the substance of which has become so altered that it cannot properly discharge its work, presents similarly illustrations of disease of an organic kind. If, as in the case of *apoplexy*, we find a blood-vessel ruptured in the brain and a clot of blood thrown into the organ producing undue pressure, we should also style such a condition that of an organic ailment.

Functional Diseases.—The second class of diseases is of a different order. These are named *functional disorders*. Here there is no actual change in the substance of the organ affected. We are rather dealing in this case with an alteration in its mode of work not necessarily due to actual disease of its substance. A heart which is acting irregularly from one cause or another (say excess of tobacco) affords an example of functional disorder. There is no actual *lesion* or alteration of the heart's structure. That organ is exemplifying a simple irregularity of action due to the influence of the tobacco poison; when that influence is removed, the action of the heart becomes normal or natural. Similarly, where from one cause or another con-

nected with irregularity or unwise feeding, pain is experienced in the stomach and other symptoms of indigestion are present, there is probably no disease or ailment represented such as involves an alteration of the stomach's structure. In such a case the symptoms disappear when a return is made to a proper diet.

The distinction between these two classes of disease may perhaps be made clear if we compare the body or organ affected to a watch. If the watch is going fast or slow, and thus deviating from its natural duty of correct time-keeping, a slight alteration of the regulator will restore it to its natural mode of working, Here we should say the ailment of the watch represented a functional disorder. Where, on the other hand, the mainspring is broken, or where some part of the mechanism of the watch has become damaged, the duties of time-keeping will be incapable of being performed until the defect has been made good. In the latter case the watch may be compared to a man suffering from an organic ailment. Naturally it is ailments of the latter kind, involving more or less serious changes in the structure of organs, which are to be regarded as of the greatest importance.

Acute and Chronic Diseases.—Another distinction which has to be drawn between diseases is that depending upon their period of development and duration. We are accustomed to speak of ailments as being *acute* and *chronic* respectively.

By an acute attack we mean one which runs a definite course, and then terminating, leaves the body practically in a healthy state. It is the case of an ailment which, lasting a certain period, is then over and done with. On the other hand, an ailment may pass into a more lasting state when it becomes of the *chronic* variety. In such a case a disease may be more or less constantly present in the case of the individual affected, not always attaining a high measure of development, but still existent in his frame and liable to show special developments and signs of waking into activity when conditions unfavourable to his health are represented.

To select an example, a person having a smart attack of *winter cough* or *bronchitis* will ordinarily recover his health in a week or two. He then presents his normal state; the disease has run its course and been cured. If, on the other hand, this first acute attack is not properly treated, it will pass into the chronic state and will be periodically developed as the result of cold, or may, indeed, be more or less constantly present. In the case in question it is likely that on the slightest touch of cold the cough will break forth anew and all the symptoms again be represented. Here the case is one of *chronic* bronchitis.

In gout and rheumatism we find excellent examples of the

difference between acute and chronic cases of attacks. An attack of *acute rheumatism* (otherwise *rheumatic fever*), if properly treated, may leave the patient perfectly well; and unless he is exposed to cold and chill under circumstances similar to those which caused his first attack, he will remain free from the ailment. If, however, the first ailment has been of a severe character, and if proper and energetic treatment has not been adopted, it will be liable to pass into the chronic state. In a typical case of this kind we might find the joints permanently affected. So with *gout*, a disease which is extremely apt to develop a lasting nature and to affect the body at large. Indigestion itself may, if not properly treated, become of a chronic variety, and a very large amount of suffering may be experienced in such a case through the lasting inability to partake of ordinary food and to digest it.

What is Diagnosis?—Pain as a Symptom.—The process of investigating the symptoms or signs of disease and of forming a judgment regarding the nature of the ailment present constitutes what is called the *diagnosis*. It has already been remarked that the success of the physician in treating any case will largely depend upon the correctness with which the meaning of the symptom is read and construed.

One of the most prominent symptoms of disease at large is of course *pain*. The degree of pain which may be represented varies extremely, and the character of the pain is also a point to which the attention of the physician is especially directed. Between mere discomfort and pain of an acute and agonising character there stand all degrees and variations. Thus the pain which characterises inflammation is of a less acute nature than that which is experienced, say, in a case of toothache or neuralgia. It is of great importance not merely to note the quality of the pain, so to speak, but likewise the period of its duration and also its situation. Occasionally the particular site of a pain will lead to a fairly accurate estimate of the nature of the ailment of which it forms a feature. Suppose a case in which a person is attacked more or less suddenly by a severe pain in the lower part of the belly at the right hand side. In such a case the attention of the physician would be at once arrested by this symptom, which might be indicative of inflammation of that part of the bowel known as the *appendix*. If this happens to be the case, the further development of symptoms would point to inflammation constituting the disease known as *appendicitis*.

A dull pain in the same region, accompanied by symptoms increased on pressure which may be described as those of gurgling, along with headache, prostration, and weariness, would probably suggest the com-

mencement of an attack of typhoid fever. Pain in the ball joint of the great toe, accompanied by inflammation, naturally sends our thoughts in the direction of an attack of gout. When other joints are affected, and more than one joint involved with pain, loss of power of movement, and swelling, the idea of rheumatism would at once occur to us.

Other Symptoms.—Later on reference will be made to the particular modes employed by physicians in reading the signs which diseases present to view. For the present we may allude to certain other signs and symptoms of disease which characterise ailments at large. Pain itself naturally indicates some derangement either of an organ itself or of its functions, or both. We have seen that the situation of the pain may form an important point connected with the diagnosis of disease. In the case of many ailments, as will be shown in subsequent sections of this work, certain external manifestations are apparent in the shape of *eruptions* of various kinds. These eruptions are very characteristic of two classes of disease. There are first those connected with *fevers* at large, each fever having its own and characteristic mode of declaring its presence through the signs to be discerned on the surface of the skin. The second class of diseases which presents in the shape of eruptions very definite means of enabling us to understand their nature, is represented by *skin troubles.* Then again each skin disease shows its own special symptoms in the character of the eruption, and the ability to distinguish the difference between one kind of skin ailment and another will largely depend on the experience of the physician in clearly recognising the features each ailment presents to view.

It may truly be said, however, in the matter of recognising the symptoms of disease, that there is scarcely any feature of the body which may not in its way present characteristics of importance in enabling us to appreciate the exact kind of departure from health which has taken place. Thus even the character of the face and its expression may afford an indication of the presence of certain ailments. The colour and character of the skin also present means of diagnosis. It would not require, for example, a very skilful person to form a correct opinion regarding the cause of extreme paleness, or even a greenish look of the skin, in the case of a young woman, otherwise feeble, to decide that she was suffering from *anæmia,* and especially from that form of the disease to which the name of *chlorosis,* or "green sickness," is applied.

Physical Examination of the Body.—The further points connected with the determination of disease from bodily symptoms are found in the examination, by various methods, of the organs and

the fluids (or secretions and excretions) of the body. When the physician is called upon to deal with a case of disease involving the organs of the chest, for example, he employs for this purpose a *stethoscope* (Figs. 2 and 3).

By means of this instrument the sounds produced by the heart, and those connected with the movements of the lungs, are transmitted to his ear in a clear and distinct fashion. Knowing what are the natural sounds thus produced, the trained ear of the doctor enables him to detect any departure from the normal in this respect. The sounds of the heart, for example, where there is disease of a valve, afford to him a clear indication of what is wrong. In a case of *pleurisy* there will be a different series of sounds heard from those present in bronchitis or in inflammation of the lungs.

Fig. 2.—Simple Stethoscope.

Again the physician is enabled by other means to ascertain the condition of the lungs by what is termed *percussion*. In such a case a small hammer and a disc called the *pleximeter* may be used. Some physicians, however, place the first two fingers of the left hand on the chest to represent the pleximeter, using the tips of the corresponding fingers of the right hand in place of the hammer. This mode of eliciting, as it were, the "notes" of the chest, is found to be extremely useful in enabling the physician to detect the presence, say, of dulness, where there should be resonance, and to note other characteristics indicating departures from the natural state of the chest organs.

Amongst other symptoms to which very great importance must be attached are those connected with the degree of *temperature*, or heat of the body. The state of the tongue, the rate and character of the pulse, the exact nature of the urine (or secretion of the kidneys), all form important points for the physician, while in many instances he requires to direct special attention to the exact nature of the bowel-discharges. With regard to the latter point in the diagnosis of disease, an illustration may be obtained from the case of typhoid fever. In that ailment sooner or later there is developed a condition which results in the passage from the bowel of a particular kind of discharge, to which the name of "pea-soup" motion has been applied. Taken in conjunction with other symptoms, this latter character would prove of great value to the physician in settling the exact nature of the ailment with which he had to deal. Similarly in cases of liver troubles the examination of the motions, and the determination of

their particular colour, may aid the physician towards forming his diagnosis of the particular condition of the liver itself.

Lung Symptoms.—With reference to other bodily excretions which are capable of affording indications of the presence of disease, we may confine our attention to the secretions of the lungs and to that of the kidneys. In dealing with *chest diseases*, the character of the cough and the quality of the expectoration, or matter, which is brought up from the lungs, is of great importance as an element in diagnosis. To this may be added the features presented by the breathing itself. In the sections of this work dealing with ailments of the lungs, these points will be fully discussed in connection with the features of each disease. With reference, however, to the general character of *cough and expectoration*, it may be here noted that it is of importance to note at which period of the day the cough is most pronounced. The special character of the cough itself is also of importance, and the difference between the cough, or whoop, of a child affected with whooping-cough, and that noted in croup, would form an important point in determining the presence of a particular disease. The expectoration in the case of bronchitis is of a clear and frothy character, becoming later on of thicker substance, and presenting a somewhat yellowish aspect. If inflammation of the lungs be present, the cough in the later stage will bring up matter which is of a red colour, due to the inflammation having caused a certain amount of blood to escape from the vessels of the lungs. Very important also is it to note the character of matters brought up from both lungs and stomach, not merely in respect of their quality, so to speak, but also it may be in respect of their odour. Where there is serious disease of the stomach or lungs, such as of the nature of cancer, the matters brought up will generally possess a highly offensive odour.

FIG. 3.—Binaural Stethoscope (for two ears).

The Stomach.—With reference especially to vomited matters great importance must be attached to this source of information. In any case of suspected poisoning it is of the highest importance that these matters be placed in a clean vessel, sealed up, and duly pre-

served. In certain diseases of the stomach the matters which are vomited will require examination with the view of detecting the presence therein of any features likely to lead to the formation of a definite opinion regarding the ailment. If, for example, in matters vomited from the stomach there is a suspicion of the presence of blood, we should be warranted in believing that some form of ulceration or other would be most probably the cause of this particular appearance.

The Tongue.—The examination of the tongue is also of great importance in determining the presence of disease. Every one is familiar with the appearance of the tongue in cases of stomach disorders and in diseases of the digestive system at large. The covering membrane of the tongue and the lining membrane of the mouth being continuous with that of the stomach, any condition affecting the latter organ is likely to be represented also on the tongue surface. In the case of certain diseases the state of the tongue may afford, among other symptoms, an important aid to diagnosis. Nurses are very familiar with examples of the so-called *strawberry tongue* seen in scarlet fever. At first in this disease it is covered with a white fur, but later on it becomes of a red colour, and as its little points or projections stand out from the general body of the organ, a strawberry-like appearance is thus given to it. Another symptomatic tongue is that seen in the disease known as *diabetes.* Here it is extremely dry, and is of a red colour, and also exhibits a certain glazed appearance, which is highly characteristic.

About the Pulse.—The *pulse* naturally affords one of the most important indications of the presence of disease. This depends on the fact that the pulse indicates to us the rate at which the heart is beating, and the manner therefore in which the circulation is being controlled. To feel the pulse properly, and to understand the main features it is calculated to impress upon us, are points which every intelligent person should be able to appreciate. By the term *pulse* we mean to indicate the wave-like motion or impulse of a blood-vessel known as an *artery.* The vessel is highly elastic, and as with each stroke of the heart a wave of blood is propelled through it, the artery, in view of its elasticity, responds, as it were, to the wave. It is these arterial waves which therefore constitute the "pulse," and their number will correspond naturally to the number of beats or contractions of the heart. Every artery being in direct communication with the left side of the heart exhibits a pulse, so that wherever an artery is present we are capable of investigating this symptom. Thus a pulse can be felt in the artery of the temple, another about the middle of the edge of the lower jaw, and another in the inner aspect of the

upper arm, but the most convenient position in which the pulse is felt is that at the wrist.

Feeling the Pulse.—The proper situation for feeling the pulse is on the thumb side of the wrist. The arm should be kept in the extended position, and the first and second fingers together used to press lightly upon the artery about an inch above the root of the thumb on that side of the hand. It is quite a common practice to see people endeavouring to feel a pulse using their own thumb for this purpose. This is an entirely erroneous mode of taking a pulse, for the reason that in one's own thumb there may be a considerable amount of beating which necessarily interferes with the correct appreciation of pulsation in the arm of the patient.

Certain important points in connection with the examination of the pulse are to be noted. In the first instance all excitement on the part of the patient should be avoided, since any disturbance of mental or physical kind is certain to cause a temporary increase in the rate of the heart beat. In the next place, the beats of the pulse should be accurately counted by the aid of the minute-hand of a watch. It will probably be best to count the pulse at least for the space of a minute, comparing the number of beats during the first half of the minute with those during the second half. It is likewise of great importance to know what may be termed the character of the pulse. According to the number of beats we are enabled to determine, for example, whether there is fever present, when the number of beats will be rapid, or if, on the other hand, when its beats are slowed, whether there exists any condition of the nature of prostration and depression.

The Natural Pulse and its Variations.—We may take it that in the adult man the normal rate of the pulse beat will average from 72 to 75 times per minute. There can be no doubt, however, that many ordinary circumstances may cause acceleration of the rate. Thus, after food, or after taking exercise, or from any cause allied to excitement of mental kind, the pulse beats will rise in number. In woman the pulse may exhibit a slightly greater number of beats per minute than in man. A quick pulse is not merely found in fevers, but also occurs in anæmia or bloodlessness. It is also characteristic of conditions represented by failure or weakness of the heart, and by most nervous disorders. In many cases of gout there is an increase of the pulse-rate. On the side of slowness of the pulse we may note that this is found only in certain cases as far as disease is concerned. All ailments which tend towards prostration and a general lowering of the system will slacken its beat. This feature is seen in jaundice and in fatty heart.

An important point connected with the observation of the pulse is that which warns us to note its character, whether it is full and bounding and strong, or whether, on the other hand, it is weak and feeble. Also it may be of importance to take note of the fact of its being *intermittent or irregular*, that is to say, whether its beats succeed one another at regular intervals, or whether there is an irregularity represented in the number and succession of beats. We find thus a pulse much quickened and irregular in its action in cases where an excess of tobacco is represented, and we may add a like result may follow the excessive consumption of tea, especially in the cases of anæmic women.

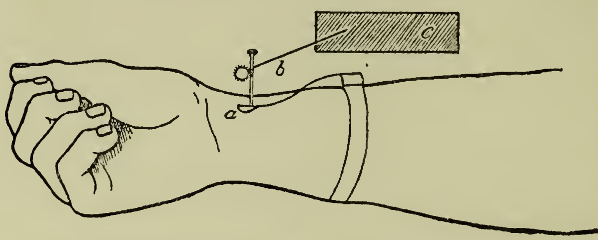


FIG. 4.—Sphygmograph applied as in taking a Pulse Tracing. *a*, Part pressing on Artery; *b*, Lever recording Tracing on the Plate *c*.

Pulse Tension.—Another characteristic of the pulse is that which is seen in the condition to which the name of *high tension* is applied. While in a natural pulse the blood-vessel can hardly be felt between the beats, in the pulse in question it can be plainly felt. A pulse of this kind is often associated with a weak or altered state of the blood, as in the case of *Bright's Disease*, a kidney trouble. It is found in the drunkard and in some varieties of poisoning, *e.g.*, lead-poisoning. Where, on the other hand, a *low tension* pulse is present we find that on compressing the blood-vessel we practically suspend its function for the time being. This variety of pulse is generally associated with conditions of bodily weakness at large.

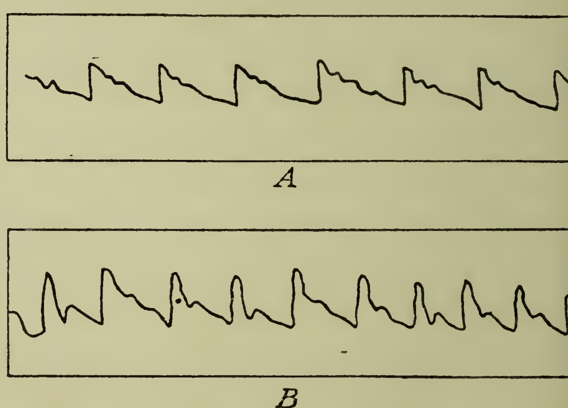


FIG. 5.—*A*, High Tension Pulse Tracing. *B*, Low Tension Pulse Tracing.

Pulse Tracings.—By means of an instrument called the *sphygmograph* (Fig. 4) tracings of the pulse can be taken on a strip of paper or blackened plate. In this way the heart is practically

made to write its own story, and records taken by means of this instrument can be filed for comparison day by day. Such records (Fig. 5) are also extremely useful and important, as tending to show the different results produced on the action of the heart by the administration of different drugs.

The Urine.—The examination of the *urine* constitutes in itself one of the most important of the means at the disposal of the physician for ascertaining not merely the exact condition of the kidneys themselves, but also of the body at large. There is scarcely any bodily organ the action of which, when obstructed, fails to exercise some effect or other on the urine. Reserving for the section of this work dealing with the kidneys and their diseases a full account of the urine, its nature, and the mode in which it is secreted, we may for the present note the more general information in the way of disease which this fluid is capable of affording.

In twenty-four hours a healthy man may pass from 2 to 2½ pints of urine. The quantity, however, will depend upon various circumstances, such as the amount of food which has been taken and the kind of food, and also the amount of exercise and the season of the year, as affecting the work of the skin. In certain diseases a marked feature is an enormous increase in the quantity of the urine passed. In the disease known as *diabetes* large amounts of urine may be passed, and of certain kidney diseases an increased quantity is also characteristic. Curiously enough, in ordinary cases of *hysteria*, occurring chiefly in women, the quantity of urine passed may be enormously increased. In recovery from many diseases of an acute nature we may also note an increase in the secretion of the kidney, while on the other hand, in inflammation of the kidney, in fevers, and also in cases of diarrhœa, or cholera, where the skin action is exaggerated, the quantity of urine will be diminished.

It is of importance to notice the characteristics of the urine as represented by its colour and also by the presence of any sediment which may exist. Urine, for example, of a dark brown colour, is found in connection with certain diseases, and is most frequently due to blood having been passed with the secretion of the kidney. In health the urine is of a yellow colour and its odour is faint. If the tint of the urine be of a brownish-yellow or somewhat green the presence of bile may be suspected. Curiously enough, certain drugs may impart special features to urine. If rhubarb or senna be administered the urine tends to develop a dark brown colour. In cases of poisoning by carbolic acid the urine is also of a dark tint. The administration of quinine produces an effect in darkening

this fluid, whilst in fevers at large the urine is usually of a darker colour than is normal.

With regard to its general character the urine is of acid nature, but this is stated to be less marked in the early part of the day than later on. The modes of testing urine in order to ascertain the presence of diseases of different kinds will be described in the section devoted to ailments of the kidney. It may be also noted that an important element in the diagnosis of disease through the urine is constituted by the examination of its deposits or sediments by means of the microscope.

Temperature as a Guide to the Diagnosis of Disease.—The indications of the presence of disease derived from *the examination of the temperature* or *heat of the body* are probably second in importance to none. The production of our bodily heat is intimately connected with the consumption of food, and in itself represents a condition which is markedly liable to be affected by the agencies which produce disease. Hence, as the result of experience, the physician is accustomed to attach great importance to variations in the temperature in the case of most diseases, and without doubt a very considerable advance was made in the art of accurately diagnosing illness and its nature when the *clinical thermometer* became an instrument of common use.

Variations in Temperature.—The natural heat or temperature of the human body is about 98.4 degrees (Fahrenheit). Slight variations both above and below this normal temperature are by no means inconsistent with health. Thus, exposure to heat and to cold climates, the taking of foods and drinks, fasting, exercise, and prolonged mental efforts are all conditions which have the effect of either increasing or decreasing the degree of bodily heat.

It may be useful here to note the range of temperature. If we begin with the normal temperature, we find this may range from 98.4 to 97.5 or 99 degrees; when the temperature is lower than natural it will range from 96 to 97.5 degrees. If lower than this we come upon a stage which may generally be termed "collapse." Here the temperature will sink to 92 degrees, and vary from that point up to 96. In the direction of increase of temperature we find that what may be called a slight degree of feverishness may show a temperature varying from 99 degrees to 101, but in the evening this latter condition may raise the temperature to 102 or 102.5 degrees. Where actual fever exists the morning temperature may range from 101 to 103. The evening temperature will generally be much higher, and may in a severe case rise to 105. Temperatures at and above 105 degrees may be considered as indicating danger.

The Clinical Thermometer.—The *clinical thermometer* (Fig. 6), an appliance which should be found in the hands of every intelligent man and woman, consists of an ordinary instrument modified for purposes of easy application to the body. All modern thermometers are of the *self-registering description*, so that after a temperature has been taken the register remains to indicate the degree of heat noted, until it is distributed and placed in a position for making a fresh observation.

If we look at the little column of mercury inside a thermometer, we shall see above it a piece of mercury detached from the main column. This is known as the *index*. It is of importance that this index should first be shaken down, *so that its top falls below the normal temperature as marked on the scale.* In this way, if the temperature is below the natural we are able to note that fact, whilst any rise of temperature will naturally send the top of the index above the mark on the scale which indicates the natural degree of heat, viz. 98.4 degrees.

FIG. 6.—Clinical Thermometer.
The black mass represents the *index*, and the arrow the normal temperature.

How to Read the Thermometer.—Turning now to the scale of the thermometer, we see that the scale ranges from 94 or 95 degrees to, say, 110. Each degree is marked by a prominent line, *the natural temperature*, 98.4, *being indicated by an arrow* (Fig. 6). The space between each degree is divided into five by means of smaller lines, thus enabling us to obtain a fair amount of accuracy in exactly estimating the temperature. Suppose that the top of the index is arrested at any one of the longer lines representing degrees, the result would naturally be indicated by simply noting the degree in question. If we suppose, on the other hand, that the temperature was normal, and that the top of the index is arrested at the second short line above the longer line marking the 98 degree, we should therefore feel inclined to write this temperature down as $98\frac{2}{5}$; but as it so happens that as records of temperature are always written according to the decimal system, we have simply to turn any fraction of a degree into a decimal. Every fifth of a degree being equal to $\frac{2}{10}$, we therefore see that $98\frac{2}{5}$ naturally becomes 98.4. If the top of the index stood at the fourth short line above any degree—say 99, for example—this would be equal to $99\frac{8}{10}$ degrees, and would be written down 99.8.

These examples will indicate the mode in which these useful indications of disease are obtained.

How to take the Temperature.—It remains now to say a word or two regarding *the manner in which the temperature may be taken* as regards the application of the instrument to the body. It should be noted that it is necessary in cases of ordinary disease to take the temperature *twice daily—morning and evening* being the usual periods. This practice has for its basis the fact that in many diseases a rise of temperature takes place at night, and it is of importance to note this fact when it is represented in the history of the patient.

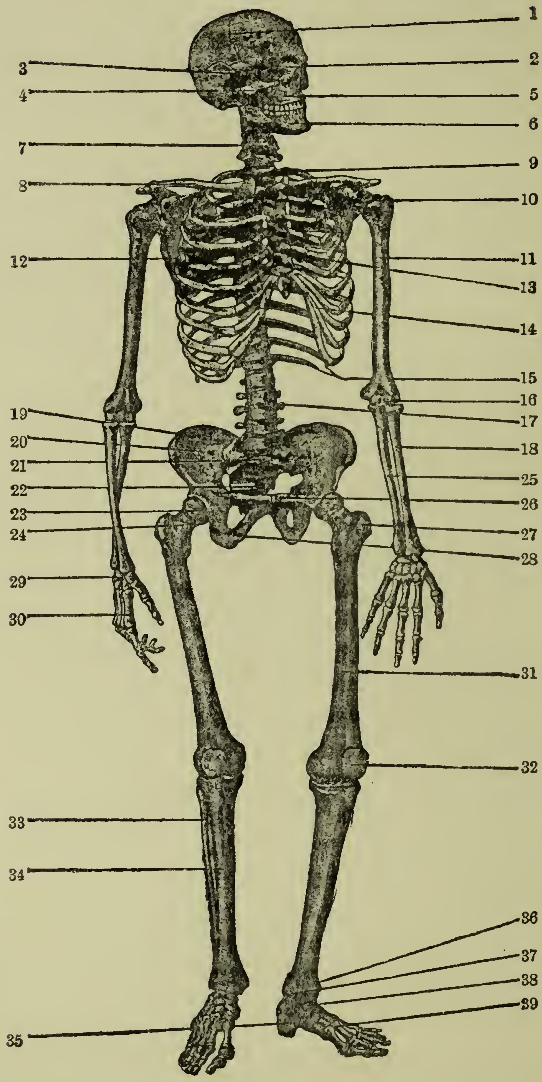
Every nurse knows how to mark a chart of the temperature, so that at a glance the doctor is able to note the daily condition of his patient as represented by the variations elicited by the use of the thermometer. There are four situations in which the temperature may be taken. The *mouth* is generally chosen, although certain disadvantages are connected with the use of the instrument in this region. The most prominent of these is the fact that the bulb of the thermometer being allowed to rest below the tongue of the patient, it may come in contact with his teeth, in which case an erroneous result may be obtained. The second region is the *armpit* or *axilla.* Occasionally the physician finds it necessary to introduce the thermometer into the *rectum* or *bowel,* whilst in certain cases it may be placed in the *vagina* or canal of the female generative organs. The temperature in the mouth can be taken more quickly than in the armpit. When placed in the mouth the index, as in all cases, must first be shaken down below the normal degree. It may be held a few minutes in the hand by way of warming it, then the bulb has to be placed far back beneath the tongue and the mouth closed upon it. The thermometer being held by the lips, breathing takes place of course through the nostrils. In three minutes at most, an ordinary good thermometer will give the result. Care must be taken that the thermometer must not slip between the cheeks and the gums, otherwise a false result will be obtained.

In taking the temperature in the armpit the bulb of the instrument should be securely placed right in the interior of the cavity, and we should see that nothing in the shape of clothing comes between the thermometer and the skin. The arm must then be placed across the chest so as to completely close the armpit, and thus afford the best chance of obtaining a correct temperature. Allow the thermometer in this position to remain for five or six minutes at least.

If the temperature be taken in the rectum or bowel, the instrument should first be anointed with oil or vaseline, and the bulb

passed into the bowel. The end of the thermometer must of course be allowed to project from the aperture of the anus. Three minutes will probably be sufficient for an observation to be taken in this situation. Especially in the case of children the bowel temperature is assumed to be most reliable. A little care and firmness is alone needed to conduct this operation successfully in the case of children of any age.

The mode of using the thermometer alluded to in the special case of women does not differ from the practice where the temperature is taken in the bowel. The instrument is introduced into the passage and left there, the legs of the patient being placed close together. A period of three minutes will be sufficient for the ascertaining of the temperature according to this latter method.



ADULT MALE SKELETON VIEWED FROM THE FRONT.

1. Frontal-bone and junction with Parietals. 2. Nasals. 3. Temporal. 4. Cheek arch. 5. Upper Jaw. 6. Lower Jaw. 7, Neck Vertebræ (seven). 8. Clavicle. 9. First Rib. 10. Shoulder-joint. 11. Humerus. 12. Edge of Scapula. 13. Breastbone. 14. Lower Ribs. 15. Floating Ribs. 16. Elbow-joint. 17. Lumbar Vertebræ (five). 18. Radius. 19. Crest of Haunch-bone. 20. Cavity of Pelvis. 21. Top of Sacrum. 22. Sacrum. 23. Head of Thigh-bone. 24 and 27. Great Trochanters of Thigh. 25. Ulna. 26. Pubis. 28. Ischium. 29. Wrist. 30. Hand. 31. Thigh-bone. 32. Knee-cap. 33. Fibula. 34. Tibia or Shin. 35. Heel-bone. 36. Lower End of Tibia. 37 and 38. Ankle. 39. Instep and Foot.

SECTION II

THE SKELETON

[*See full-page illustration* (*page* 38) *of skeleton for reference in connection with this section.*]

The Bony Framework.—*The skeleton* is the term applied to the bony framework of *Vertebrated* or backboned animals. This framework is characteristic of this great division alone. In lower forms of life we may find hard parts adapted for the protection of the body, or for the attachment of muscles, but we do not find any definite approach below the rank of Vertebrate animals to the possession of a distinct skeleton. A crab or lobster, for example, possesses a kind of skeleton in the shape of the shell which invests its body. To this shell the muscles of the animal are attached, but, in the first place, it is external to the body and not internal as in backboned animals, and, in the second place, it consists simply of *carbonate of lime* (or "chalk"), and does not in any sense exhibit an approach to either the composition or structure of bone.

The Backboned Series.—Vertebrated or "backboned" animals include five distinct groups. Beginning with the lowest, these are fishes, frogs and their neighbours, reptiles, birds, and mammals. This latter group is often popularly termed the "quadruped" class. It includes mammals ranging from the kangaroos and their neighbours as its lowest forms, onwards and upwards through whales, carnivorous animals (such as lions and tigers), hoofed animals (such as horses, cattle, sheep, the rhinoceros, elephants, &c.), onwards to bats, monkeys, and finally to man himself.

The class of mammals to which man belongs possesses certain characteristics entitling it to be regarded as the highest class of the animal world. All its members agree in possessing a covering of hair, which may be supplemented in some cases (as in the *armadillos*) by the development of bony plates, or, as in the hedgehog and porcupine, by the possession of spines, which last, however, are only modified hairs. In the second place, mammals have warm blood, a point in which they agree with birds. Their red blood corpuscles are of simple character, rounded in shape (except in the camel tribe), and do not possess a central particle or *nucleus*. Another

character of man's class is found in the four-chambered condition of the heart, but this feature is one likewise shared by the birds. The lungs in quadrupeds are always perfectly closed sacs or bags, and are therefore unlike those of birds, which present openings on their surface. The main feature, however, which distinguishes mammals from all other animals is the fact that their young are born alive, and are nourished by means of the secretion of the milk-glands. These latter are merely modified skin-glands in their nature. We thus note that man stands at the head of the highest class of the animal world, and whatever view may be adopted regarding his origin and past history, it is clear that the process of development as represented in his history has evolved the most perfect product of the animal world.

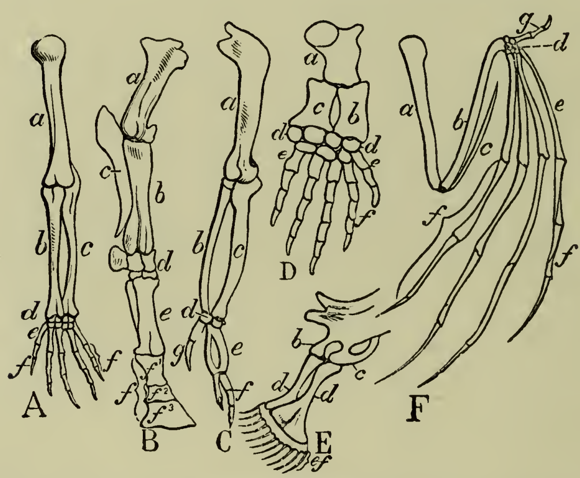


Fig. 7.—Fore-limb of Man (A); Horse (B); Bird (C); Whale (D); Fish (E); and Bat (F); showing same general type. *a*, The Humerus; *b*, Radius; *c*, Ulna; *d*, Wrist; *e*, Palm; *f*, Fingers; *g*, Thumb.

General View of the Skeleton.—Turning to the consideration of man's skeleton, we find, first, that it is built up on the same type as that of every other backboned animal. Broadly regarded, we see in every skeleton a central portion known as the *spine* or *backbone*. All the parts of the skeleton are more or less directly attached to this central portion, which is to the body what the keel is to the ship. The head for example is borne on one extremity of the spine, whilst to its sides are attached the limbs and those bones forming the *limb-girdles*, on which last the limbs themselves are supported. This general type of skeleton is found, as has been remarked, throughout the whole backboned series. The differences which exist between the skeletons of high and low animals depend therefore not on any actual difference in the plan or build of the skeleton, but on the degree of development which its various parts exhibit. An interesting proof of this general correspondence between the skeletons of different animals may be found in a comparison of the bony framework of the limbs. The arm of man (Fig. 7) for example shows essentially the same bones and the same arrangement of these bones as

are exhibited in the breast-fin of the fish, the foreleg of the frog, the paddle of the whale, the foreleg of the horse, the wing of the bat, and the wing of the bird.

Limbs and their Type.—It is sufficient to glance at the general arrangement of the bones in such a series of limbs to convince us that they are constructed on one and the same type. We note, however, that the differences between them are due to the manner in which they are respectively used. Man's fore-limb is adapted for grasping and for performing all the other functions associated with the possession of a perfect hand, whereas the fore-limb of the horse is adapted for swift progression, as also is that of the dog, while turning to the fore-limbs of bat and bird we find them modified, each in its own way, for purposes of flight. From these considerations we are led forward to an idea of the manner in which the process of evolution has worked out the variations and differences presented by different groups of animals. The notion here conveyed to us is not that of the special creation of each individual group, but rather the modification of one common and original type to suit varying conditions of life.

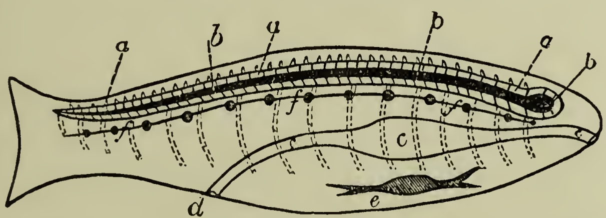


Fig. 8.—Plan of the Vertebrate Body, showing Spine (a), Nervous System (b), Digestive System (c), and Heart (e). The Sympathetic Nervous System is shown at f; d, Anus.

The Backboned Plan.—In addition to the skeleton being built up on one and the same type, it is interesting to note that the general arrangement of the organs of the vertebrate body also exhibits a common plan. If, for example, we make a longitudinal section of the body of any backboned animal from the fish upwards to man (Fig. 8), we find that body to be composed, roughly speaking, of two tubes. One of these tubes lies above the other, and consists of the skull and spine. Within this bony tube are protected the great centres of the chief nervous system of the body. Below this tube lies another bounded by the ribs and the walls of the body at large. Inside this second and lower tube are contained, first, the digestive system occupying the middle position of the tube, whilst the heart lies lowest. Between the digestive system and the spine lies another nervous system called the *sympathetic*. This arrrangement of parts, it may be repeated, characterises all backboned animals, and a familiar illustration of the fact that the backboned body consists of two tubes may be found in the carcase of a sheep or bullock which the butcher has divided longitudinally by sawing it down through the

backbone. If we look at such a section of an animal we note the backbone, which encloses *the spinal cord*, the great main line of the nervous system. The other cavity of the body, from which the butcher has removed all the organs, corresponds of course to the second tube. Similarly, if a fish be gutted, the organs are removed from the second and lower tube, leaving the backbone, representing the upper tube within which the nervous system is contained, untouched.

Man's Special Characters.—It is necessary that we should note certain of the anatomical characteristics on the presence of which man's superiority over other animals may be said largely to depend. We are here only dealing with the anatomy of the skeleton and of the body at large. We leave out of consideration entirely the high development of man's brain and nervous system. The latter development might probably entitle man in the eyes of certain authorities to be ranked in a kingdom by himself, seeing that in virtue of his brain-powers he is able to appreciate and understand matters lying utterly beyond the powers of comprehension of any lower form. But we perceive in his bony framework special features such as do not exist in their entirety in any lower animal, the bulk of these modifications having reference to his easy assumption of the *erect position*. Man is the only animal capable of assuming this position easily and without effort. The highest apes cannot retain this position perfectly or even approach to it for any length of time. In him the main line of the spine, therefore, may be taken to be of vertical or straight up and down form, and when in the erect position the joints of the hip and knee are capable of being extended, thus bringing the leg and thigh into one line. We find the foot capable of being placed on the ground resting on a broad surface formed by the toes in front, and supported by the heel behind, as by a definite *fulcrum*. The ability to assume this position is brought about by a series of very important modifications of the skeleton, and of the muscular system as well. His head is evenly balanced on the top of the spine, bringing the face well to the front. The spine exhibits a series of curves which are not represented in lower animals, and which are specially adapted also to the easy maintenance of the erect posture. In lower animals we find the spine is practically never erect in position, but oblique, or, as in the case of four-footed animals, horizontal. In them the knee-joints and hip-joints are bent at an angle, and the head is not balanced on the spine, but is practically tied or attached to it by definite supporting structures or *ligaments*.

Man's Limbs.—With reference to man's fore-limbs we find them adapted for the function of *prehension*, that is for grasping

objects. They are therefore removed from the lower duty which they perform even in higher apes of supporting the body in progression. Associated with these modifications of the bones adapting man for an erect posture, we find corresponding points noticeable in the arrangement of his muscles and joints. Thus his erect position is largely maintained by the action of the muscles of the hinder surface of the body, and by a corresponding action of those of the body's front maintaining the frame easily in epuilibrium.

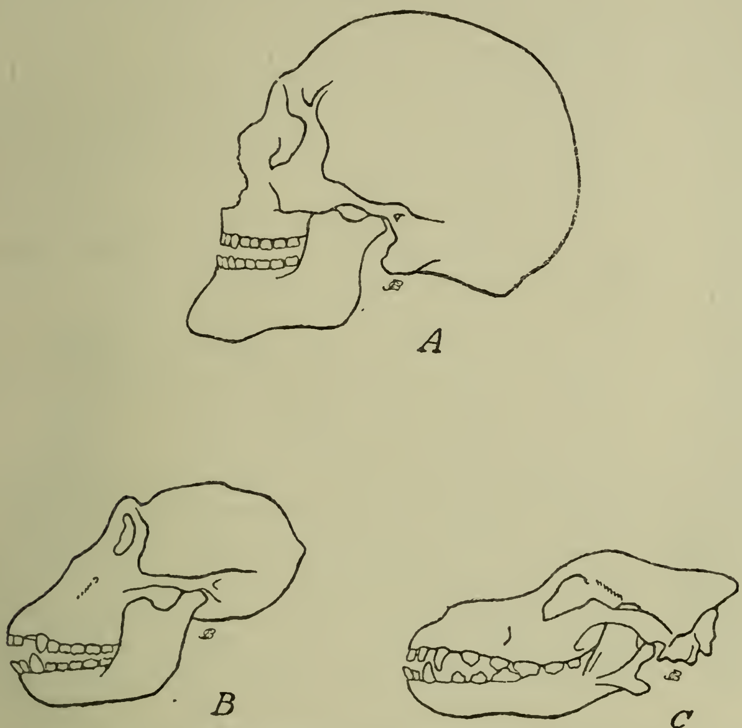


FIG. 9.—Skulls of Man (*A*), Gorilla (*B*), and Dog (*C*).

The Skull.—In respect of man's skull it may be noted that his is the only *cranium* in which the front of the skull is developed in practically the same plane as the face, so that the front of the brain and the face are brought into line. If we compare a human skull with that of any lower animal we observe that in the case of the latter the face bones project far beyond the brain case. The outline of a human skull viewed from the side, and compared with a similar outline of the skull of say a dog or of an ape (Fig. 9), would at once demonstrate the great difference whereby the cranium of man is

separated from the skulls of lower forms. This development has direct reference to the high character of the human brain.

FIG. 10—View of the Spine seen from behind, showing the processes of the Vertebræ. Below are seen the united bones forming the Sacrum, and attached to it the four Vertebræ of the Coccyx or Tail.

High and Low Skulls.—It is important to note that human skulls do not exhibit the same degree of development in respect of the shortening of the face bones and jaws, and the special development of the frontal (or forehead) region. If we visit a museum in which the skulls of the different races of men are preserved, a very cursory examination would show us that one important difference between the various *crania* takes its origin from the amount of degree of development presented by the face bones and by the frontal region respectively. The skull of a negro for example shows us face bones of far more prominent character than those of white races, whilst his frontal development is not so distinctly marked as in the latter. Races of a lower character than negroes show a still lower grade, with greater projection of the jaws, and the frontal region of the skull in retreat. These skulls are termed by the anatomist *prognathous* or *forward-jawed.* In the higher races of men, as we have seen, brain and face are practically in the same line (Fig. 9, *A*). Such skulls are called *orthognathous* or *straight-jawed.* There can be little doubt the superiority of the white races in this respect is due to the greater development of the front region of the brain than is found in lower man. As this latter region of the brain appears to be associated with the higher mental faculties, the relationship between the brain and the shape of the skull can be readily appreciated.

FIG. 11.—A Deformed Spine, producing a Variety of the "Hunchback" Condition.

The Spine.—The description of the *spine, backbone*—or *vertebral column* as it is also called—may form a proper introduction to the consideration of the anatomy of the

skeleton at large. It may be pointed out in passing that anatomical knowledge of this kind is not merely necessary for the appreciation of many points connected with health and disease, but is absolutely essential for those who desire to attain a knowledge of "First Aid," or "Ambulance" work. The treatment of *fractures* or breakages of bones, and of dislocations, can only be intelligently appreciated in its details when it is founded on a knowledge of the skeleton and the arrangement of its varied parts.

Number of Bones.—With reference to the total *number of bones* contained in the human body, we may tabulate them as follows. Dividing the skeleton into its two chief regions known to anatomists as the *axial skeleton* and the *appendicular parts*, we find a total of over 200 bones.

Axial Portion	Cranial part of skull	8
	Face portion	14
	Backbone	33
	Breastbone and ribs	25
	Hyoid or tongue bone	1
Appendicular Portion	Upper limbs	64
	Lower limbs	62
		207

In some estimates of the skeleton the total number of bones is given as 200, because, as we shall see, certain portions of the spine consist of several bones united. By some anatomists the *hyoid bone* (to which the tongue is attached) is not regarded as a distinct bone of the skeleton. It should also be noted that in the young state we find a greater number of bones than in the adult, seeing that as development proceeds, certain bones originally separate become united.

The Backbone's Structure.—Turning to the consideration of the spine itself (Figs. 10 and 11), we find it composed of 33 bones known as *vertebræ.* We may thus tabulate the numbers of the vertebræ found in the various regions of the spine.

Cervical (neck)	7	
Dorsal (back)	12	Ribs attached.
Lumbar (loins)	5	
Sacral (united)	5	forming one bone, the *sacrum.*
Coccygeal (united)	4	rudimentary vertebræ forming the *tail portion.*
	33	

The twenty-four upper vertebræ of the neck, back, and loins, numbering 24, are separate bones, and are therefore sometimes called *true vertebræ;* the latter nine, comprising the sacrum and the coccyx, are united, and are hence called *false vertebræ.*

The Plan of the Vertebræ.—The various vertebræ comprising the spine are built upon one type, but exhibit certain modifications of form due to their relative importance in the body, and to the position in the backbone which they respectively occupy. The common type (Fig. 12) of vertebræ shows us the following points:—First, a solid portion named the *body* or *centrum*, the united bodies of the bones constituting the solid part of the spine. From this "body" are given off backwards two processes, which, joining in the middle line, form a ring, or "arch." Through this arch the spinal cord passes. On the principle that if a number of arches are placed together a tunnel or tube is formed, so in the body the union of the arches of the different vertebræ forms the protecting tube for the spinal cord, called the *spinal canal.* The arch so formed ends in a prominent projection of bone called the *spinous* process. It is the row of these processes projecting along our back (Fig. 10) which have procured for the backbone the name of "spine." These processes may be felt in such an animal as the cat when we stroke its back. It may here be mentioned that the word *process* is applied in anatomy to any projecting portion of bones. From the sides of the arch spring two processes called *transverse* processes, and above and below these are seen others, two above and two below, called *articular* processes. By means of the latter each vertebræ is joined to its neighbour by a kind of interlocking. The processes described are intended for the attachment of muscles and ligaments, the latter being the tough, fibrous cords which bind bones together. Notches are found above and below in each vertebræ, and in the spine when all the bones are in their natural position, these notches form holes or apertures through which nerves emerge from the spinal cord.

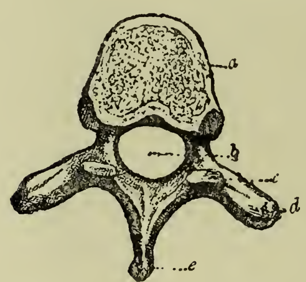


FIG. 12.—*a*, Body; *b*, the Arch; *c*, Articular Process; *d*, Transverse Process; *e*, Spinous Process.

The Vertebræ of the Neck.—It is a curious fact that there are extremely few quadrupeds in which the number of vertebræ in the neck exceeds seven or falls below it. Seven, as we have seen, is the number in the human subject; the same number is found in the giraffe, the length of neck in that animal being produced by the elongation of individual bones and not by the development of an

additional number. A certain species of *sloth* has nine neck-vertebræ, whilst another possesses six only. In some animals, as in certain whales, we may find seven vertebræ united to form a single bone. The vertebræ of our neck exhibit the ordinary type common to the vertebræ at large; they are, however, distinguished from the others by the fact that the spinous process is cleft at the tip. This character is not, however, seen in the seventh or last of the neck, and is sometimes wanting in the sixth. When we look at a neck-vertebræ we also note that in the transverse process there exists a hole through which an artery, or blood-vessel, known as the "vertebral artery," passes upwards on each side of the neck on its way to supply the brain in part with blood. The spine of the seventh vertebræ is longer than the rest, and can be easily felt in our body projecting beyond the others at the root of the neck when the head is bent slightly forward.

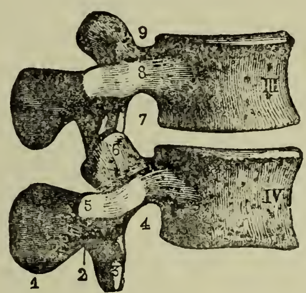


FIG. 13.—Two Lumbar Vertebræ. 1, Spinous Process; 2, Lamina; 3, Inferior Articular Process; 4 and 7, mark the points of Articulation between the Vertebræ; 5, Transverse Process; 6 and 9, Superior Articular Processes; 8, Transverse Process. In life the space between the bones is occupied by a cartilaginous plate, the "Intervertebral Disc." III. and IV. mark the Bodies of the Bones.

Atlas and Axis.—Two of these seven vertebræ are so peculiar as to warrant a special description. The first of these is the *atlas* (Fig. 10), which directly supports the head. It may be described as practically consisting of a ring of bone bearing two shallow cups above to receive two projections, or *condyles*, found on the hindmost bone of the skull. The atlas wants a centrum or body piece. It is firmly attached to the base of the skull, whilst its spinous process is small, the transverse processes being long and undivided.

The second vertebræ, or *axis*, can be distinguished from all the others by reason of the fact that on the upper surface of its body a strong bony projection, or peg, known as the *odontoid process*, is found. Upon this bony peg the head and the atlas together turn. This process is regarded as the missing body of the atlas, which, in the course of the body's development, has detached itself from its original bone, and comes thus to form the peg on which the movements of the head are performed.

Vertebræ of the Back.—These are twelve in number (Fig. 10), and as each supports a pair of ribs, this gives us twenty-four ribs as our portion. The dorsal vertebræ have thick and strong transverse processes, at the ends of which a little hollow is seen—the rib being partly supported by such an attachment. On the sides of the bodies

of these vertebræ depressions are found for receiving the heads of the ribs. The spinous processes are long, and are directed obliquely downwards, coming thus in a measure to overlap one another.

The Lumbar Vertebræ.—These vertebræ numbering five, and forming the base of the spinal column, necessarily are the largest (Fig. 13). Their spinous processes are flattened from side to side and project straight backwards. Their transverse processes are long and of a pointed shape. The lowest of these five vertebræ has a body

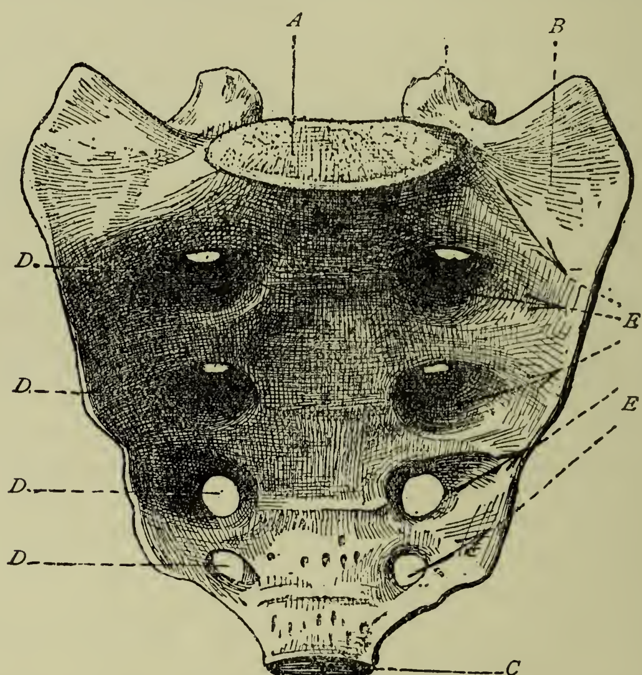


FIG. 14.—Front view of Sacrum. *A*, Top of body of first vertebra of the five. *B*, The united sides or "wing." *C*, End of attachment of Coccyx. *D*, *D*, *D*, *D*, Foramina or apertures allowing Nerves to pass out. *E*, *E*, Similar apertures on opposite side.

which is thickest in front, while its spine is not so large as are those of its neighbours.

The Sacrum.—The next region of the spine introduces us to a portion of the column which has undergone considerable modification. In the young state the single bone we term the *sacrum* (Fig. 14) is composed of five distinct vertebræ, but these in due course become united to form the single bone of the adult state. Its composition out of the five vertebræ is very easily seen on inspecting the bone itself. It is a bone of triangular shape, the base of the triangle lying upwards, and upon it resting the last of the lumbar vertebræ. The bone is con-

cave, or hollow in front and convex behind. On the hinder surface we see the projections corresponding to the spines of the five vertebræ of which it consists; below there is a surface to which the *coccyx*, or tail region of the spine, is attached.

Having regard to the position of the *sacrum*, we see that it practically forms a wedge placed between the two haunch bones. Through its solid nature it therefore helps to convert the pelvis or haunch into a firm structure on which the upper parts of the skeleton are safely supported. It would appear that in man the sacrum is broader compared with its length than in other animals. The sacrum of woman is in turn broader than that of man, this result contributing in part to the formation of a broader haunch or pelvis than in the male subject, a point bearing a distinct relation to the childbearing functions.

The Coccyx.—The *coccyx* (Fig. 10) forms the ultimate portion of the spine, which corresponds in lower animals with the tail. The number of vertebræ contained in it is four. The bones of which it is composed may be described as *rudimentary* or *vestigial* in character; in other words, owing to a lack of use or function they have degenerated in structure and become mere useless appendages. The bony parts represent practically the bodies of the vertebræ alone. There are no arches in them, and the spinal cord does not extend to this portion of the spine.

The Spine as a Whole.—The total length of the human spine on the average is about twenty-eight inches. When viewed in profile, it is seen to be anything but a straight structure. On the other hand, it exhibits *a series of very definite curves*, which bear a distinct relation to the erect position of its possessor. The first curve is that of the neck, which bulges out (or is convex) forwards. In the back the curve bulges out backwards, in the *lumbar* region it is forward again, whilst the sacral curve is markedly a backward one. A side or lateral curve is also described as commonly found to the right side in the region of the back. It is only in man that we find the curve of the loins forward.

Its Curves.—A highly important observation with reference to the human character of the spinal curves is that which teaches us that in the new-born infant these curves are practically undeveloped. They make their first appearance in the shape of the neck-curve when the child is carried about in its nurse's arms. When, at a later period of its existence, the child begins its attempts to walk, and therefore to assume the erect position, the loin or lumbar curve is developed, whilst, with increased efforts in the maintenance of the erect position, the whole of the curves ultimately appear. The clear

adaptation of the form of the human spine to the requirements of the erect posture is thus abundantly demonstrated.

A very important principle underlies the explanation just given of this particular conformation of our spine It is a familiar principle in science, that any structure which man shares in common with the lower animals will most probably be found in the earlier stages of his existence. A conformation which appears later on in the development of his body may be assumed on the other hand to represent a something peculiarly human. Judged by this standard, it is clear the curves in man's spine, found in no other animal, are to be regarded as an exclusive human possession, a point we have seen amply demonstrated by their relationship to his own special and erect posture.

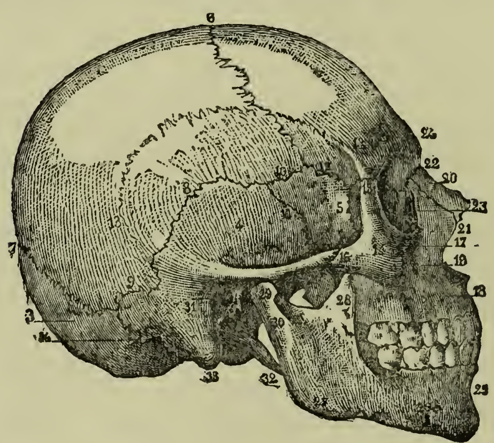


Fig. 15.—Human Skull viewed from Right Side. 1, Frontal Bone ; 2, Parietal ; 3, Occipital ; 4, Temporal ; 5, Wing of Sphenoid ; 6, Coronal Suture ; 7, Lambdoidal Suture ; 8, Temporo-Parietal Suture ; 9, Suture between Parietal and Mastoid part of Temporal Bone ; 10, Suture between Sphenoid Bone and Parietal ; 11, Suture between Sphenoid and Temporal ; 12, Suture between Sphenoid and Frontal ; 13, Temporal Line ; 14, Malar Bone ; 15, 16, 17, Union of Malar and Frontal Bones (16 rests on the Cheek Arch) ; 18, Upper Jaw ; 19, Suborbital Foramen or Aperture ; 20, Nasal Bones ; 21, 22, Union of Nasals with Upper Jaw and Frontal ; 23, Lachrymal Opening ; 24, Nasal Protuberance ; 25, Lower Jaw ; 26, Mental Foramen or Aperture ; 27, Angle of Lower Jaw ; 28, Coronoid Process ; 29, Condyle of Jaw ; 30, Neck of Condyle ; 31, Ear Opening in Temporal Bone ; 32, Styloid Process ; 33, Mastoid Process ; 34, Union of Occipital and Mastoid.

The Skull.—When we have regard to the human skull viewed in profile, we readily distinguish its chief regions or parts. There is first seen that portion which forms the brain case (Fig. 15), and which is termed the *cranium proper*, whilst, secondly, we find the lower portion composed of the bones of the *face.*

Eight bones are comprised in the cranium, while fourteen bones go to compose the face portion of the skull. Beginning with the consideration of the brain case, we find certain of the bones are to be reckoned as pairs. The first or *frontal* bone is that of the *forehead.* It ends below at about half the level of the *orbits* or *eye* cavities, whilst above it joins two bones (named *parietal* bones) which form the dome-shaped part of the head. The frontal bone is deeply hollowed out to receive the front portion of the brain, and shows above the eyes ridges which support the eyebrows.

The Parietal Bones.—The *parietal bones* (Figs. 15 and 18) are *two* in number, and are united at the middle of the top of the skull. Each of these bones is somewhat square shaped, and joins the frontal bone and certain other bones of the cranium.

The Temporal Bones.—The *temporal bones* (Fig. 15) may be known because they present the openings of the ears, and contain in their interior the complex parts belonging to the inner ear. Each bone has a solid (or mastoid) portion (Fig. 15, 33) below, which can be felt at the back of the ear, and above there is a thin portion that aids in forming what is popularly known as the *temple*. In front of the ear opening is a hollow in which the top of the lower jaw works. The outer part of each temporal bone gives it a thin arch-shaped process known as the *zygoma*. This passes forwards and joins a part of the cheek-bone, thus forming the cheek archanatomically knownas the zygomatic arch (Fig. 15, 16).

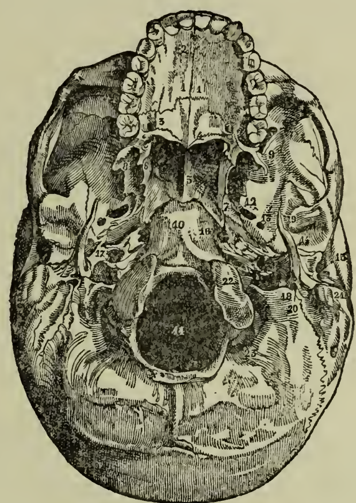


FIG. 16.—Lower Surface of Skull. 1, Hard Palate; 2, Anterior Palatal Foramen; 3, Posterior; 4, Hinder border of Palate; 5, Vomer; 6 and 8, Pterygoid; 7, Scaphoid Fossa or Hollow; 9, Zygomatic Fossa; 10, Basilar part of Occipital Bone; 11, Occipital Aperture or Great Foramen; 12, Oval Foramen; 13, Small Foramen; 14, Glenoid Fossa; 15, Temporal Fossa; 16, Aperture in Skull Base for Nerve; 17, Carotid Canal; 18, Stylo-mastoid; 19, Part of Zygomatic Arch; 20, Junction of Occipital Bone and Mastoid part of Temporal; 21, Mastoid; 22, Occipital Condyle; 23, Posterior Condyloid Fossa.

The Sphenoid Bone.—This bone is situated practically in the centre of the floor or base of the skull (Fig. 17). It is a bone of somewhat bat-shaped form, exhibiting a body and wings. This bone unites with almost every other bone of the skull and is extremely complicated in its structure, owing to the very large number of openings it possesses for the passage of the nerves from the brain outwards.

The Ethmoid Bone.—This is a small bone of somewhat spongy nature, from which fact it has sometimes received the name of the "sieve-like" bone. It lies beneath the frontal bone and in front of the sphenoid bone, and thus practically occupies a position above the roof of the nose. Through its sieve-like structure the nerves of smell pass out. This bone also helps in part to form the inner side of the eye cavity.

The Occipital Bone.—This bone (Figs. 15 and 16) forms the hindmost bone of the skull. It is situated therefore in the back of the cranium. It is readily recognised by the large hole (or *foramen*)

(Fig. 16, 11) which lies on its under surface; through this aperture the brain and the spinal cord become continuous. This hole corresponds therefore with the spinal canal of the backbone, which, as we have seen, lodges the spinal cord. On each side of the foramen of the occipital bone below, we find a projecting knuckle-like part of bone called the *condyle* (Fig. 16, 22). It is these projections which fit into the saucer-like cavities borne by the atlas or first vertebra of the neck, and it is in this way the articulation or joining of skull and spine takes place.

The Bones of the Face.—The bones of the face number fourteen, and mostly exist in pairs. They may be tabulated as follows:—

Lachrymal bones (eye-cavities)	2
Nasal bones (nose)	2
Malar bones (cheek)	2
Palatal bones (palate)	2
Turbinated bones (nose)	2
Upper Maxillary bones (upper jaw)	2
Lower Maxillary bone (lower jaw)	1
Vomer bone (nose)	1
	14

The Lachrymal bones are represented by two small bones of scale-like structure. These bones lie at the inner edge of each orbit or eye cavity, and are fitted in between the ethmoid bone, the frontal bone, and the upper jawbones. The name "lachrymal" is derived from the fact that they bear the *lachrymal glands* or those which secrete the tears used to wash the surface of the eyes.

The Nasal bones (Fig. 15, 20), as indicated by their name, form the bony support of the nose. In life the bulk of the nose is not formed of bone but of *cartilage* or "gristle." Each nasal bone is a thin, long-shaped bone. In the living body these bones would practically correspond with what is popularly known as the bridge of the nose.

The Malar bones are the cheek-bones (Fig. 15, 14), and practically form the prominence of the cheek. Each bone also assists in forming the outer part of the cavity in which the eye is contained. Below, it joins the upper jawbone, and it also is connected with the temporal bone by the arch of the cheek.

The Palatal bones, two in number, form the back part of what is known as the "hard palate" (Fig. 16). Each bone is usually described as somewhat resembling the letter "L" in shape. These bones also take part in forming the outer wall of the nose.

The Turbinated bones, otherwise called *inferior turbinated bones*, are small bones of curved shape. They exhibit a somewhat

twisted or convoluted structure, and take part in the formation of the outer wall of the cavities of the nose. The purpose of the twisted structure exhibited by these bones is an interesting one. The lining of the membrane of the nose is specially distributed to these bones, and as this membrane is profusely supplied with blood-vessels, air which is breathed in through the nose is thus warmed before it passes to the lungs.

The Upper Maxillary bones (Fig. 15, 18) are those which form the upper jaw. We thus note that although the jaw is spoken

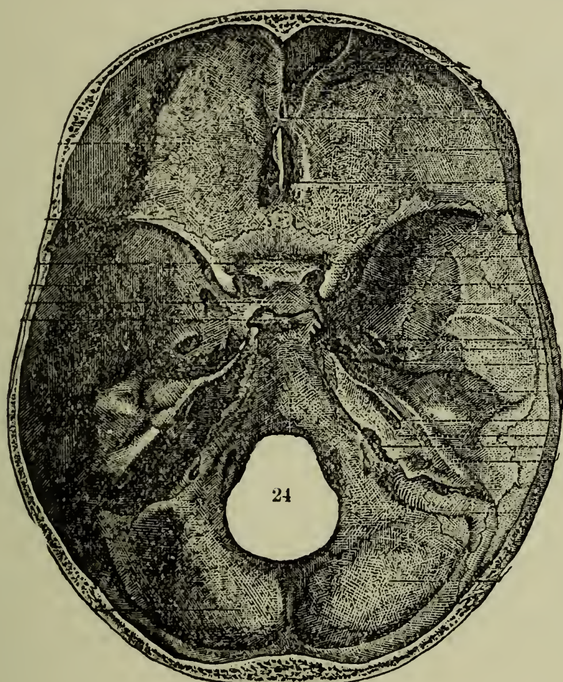


FIG. 17.—View of the Base or Flow of Skull. The great aperture of the Skull (*foramen magnum*) is seen at 24.

of in the singular, it is really composed of two bones which unite together in the middle line. This bone bears the teeth of the upper jaw, and has on its lower border a ridge of bone known as the *alveolar process*. Above it is thin, and assists to form the floor of the eye cavity, whilst it also aids in the formation of the nose. On its outer side the upper maxillary bone joins the cheek-bone, and it also takes part in the formation of the hard palate internally. The bone shows a somewhat triangular hollow called the *antrum*, which is in communication with the cavity of the nose.

The Lower Maxillary bone (Fig. 15, 25), a single bone, forms the lower jaw. This bone is the largest of the face, and it is the only bone of the skull which is separated from its neighbours. It is curious to note that this bone, which is of horse-shoe shape, is developed in two distinct halves. These halves unite together during the first year of the infant's life, the union taking place at the chin. The body of the bone is its horizontal portion, and bears the teeth. From this rises on each side the *ramus*, which passes upwards and divides into two processes; the front one is of a pointed nature whilst the hinder is of a rounded character and forms the *condyle* which rests in the hollow of the temporal bone, and thus articulates the lower jaw to the skull.

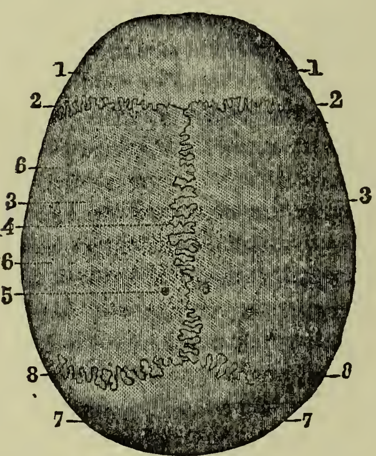


Fig. 18.—Upper Surface of Skull showing Sutures. 1, Frontal Bone; 2, Front Parietal or Coronal Suture; 3, Parietal Bones; 4, Sagittal Suture; 5, Parietal Foramen for Vein; 6, Junction of Temporal and Parietal Bones; 7, Occipital Bone; 8, Lambdoidal Suture.

The Vomer is also a single bone, and derives its name from its resemblance to a ploughshare in shape. It lies in the middle of the nose cavity and practically forms the bony portion of the partition which separates one nostril from another. Above it joins the sphenoid bone of the skull, whilst below it is connected with the upper jaw bone and the palate bones.

The Hyoid Bone.—Although not properly regarded as a bone of the skull, the hyoid bone may be so described in relation to the parts with which it is connected. This is the bone which supports the tongue. It is situated in the upper part of the neck, above the organ of voice, and in shape resembles closely the letter "U." The muscles of the tongue are attached to the *hyoid* bone.

The Skull in General.—With reference to the general conformation of the human skull, it may be described as *ovoid* in shape with flattened sides. One calculation gives its average length in Britain as slightly over 7 inches, its breadth about 5½ inches at its broadest point, and its height or depth from the top to the base of the occipital bone about 5¼ inches. The average circumference is set down at 21 inches, whilst the mean capacity of the brain is estimated at 92 cubic inches. The changes which the skull undergoes at different periods of life present many features of extreme interest to the anatomist. There is a great disproportion in the infant

between the size of the skull and the face. The latter in the infant does not form more than one-eighth part of the entire head, this fact being largely due to the want of development of the jaws and teeth. Regarded from the adult point of view, the face is generally estimated to measure about half the size of the head. With regard to the difference between the skulls of the sexes, that of woman is smaller and of lighter texture than that of man, an observation which may be extended to the skeleton at large. With regard to the capacity of the female skull, this is set down at 10 per cent. less than the cranium of man. In woman also the face is usually smaller in proportion to the cranial parts. Anatomists agree that, regarded generally, the skull of woman more nearly represents the character of the infant cranium than does the cranium of the male sex.

The Sutures of the Skull.—The word *suture* is derived from the Latin term *sutura*, meaning a "seam." It is applied in anatomy to the lines of junction or union of the bones of the skull. Regarded from one point of view these sutures might be described under the head of *joints*, but it may be most convenient to consider them in connection with the description of the skull itself.

If we regard the sutures as "joints," they must be considered to represent what are called fixed joints or fixed articulations. A typical suture may be seen in the front of the skull (Fig. 18), where one termed the *coronal suture* crosses the cranium. This is the suture which unites the frontal bones with the two parietal bones. Another which runs along the middle of the skull, joining the two latter bones to form the domelike portion of the head, is called the *sagittal suture*. We see here the manner of union between the skull bones which is adapted to secure their due growth up to a point when the cranium becomes more or less solid. We note in each suture the toothed edge of each bone, and the union is therefore produced by the interlocking of the edges in question. In old persons the lines of union of the skull-bones, distinct enough in earlier life, usually become entirely obliterated. This process takes place through the fibrous substance existing between the bones becoming absorbed or converted into bone.

Other chief sutures of the skull are the *squamous suture* between the scale-like part of the temporal bone and the lower edge of the parietal bone. Another is the *lambdoidal suture* found at the back of the head (Fig. 18), whereby the occipital and the parietal bones are joined. The *transverse suture* is that found in the face above, at the level of the eye cavities. It is here that the face and the cranium are joined together.

Skull Growth.—In the growth of the skull the membrane situated between the various bones continues to produce new bone, and therefore causes the increase of the head in size. Occasionally as a diseased process, or at least as something not consistent with the perfect development of the body, a too early formation of the bone in any region of the skull may produce deformity of the head. The sagittal suture on the top of the head is that which is perhaps most frequently connected with skull-deformity. If the growth of the skull in breadth is thus interfered with we find the cranium compelled to increase by way of making room for the brain in another direction. Hence we find a head-development of extremely elongated shape. Such a skull is known to anatomists as *boat-shaped* or *scaphoidal*.

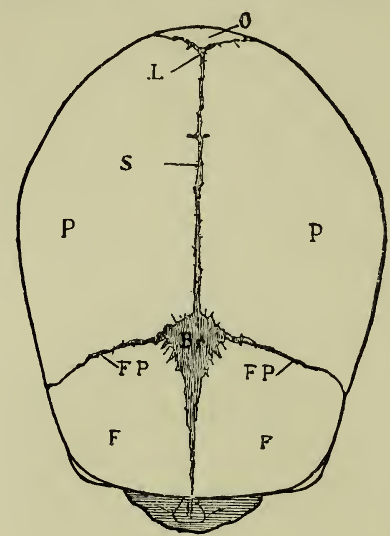


Fig. 19.—Skull of Child at Birth, showing the Fontanelles, &c. O, Occipital Bone; P, Parietals; F, Frontal Bone; S, Sagittal Suture; FP, Fronto-parietal or Coronal Suture; L, Posterior Fontanelle or Lambdoidal; Br, Anterior Fontanelle, Great or Bregmatic.

In the young infant the divisions between the bones of the head can be easily perceived (Fig. 19) before the natural process of skull growth just described takes place. These divisions are gradually obliterated when the adult conformation of the head is duly completed.

THE THORAX, OR "CHEST"

The description of the *thorax* or *chest* may be said to complete our survey of the *axial skeleton*, or that corresponding to the *trunk* of the body. The chest itself forms the upper of the two cavities of the body. The lower cavity, called the *abdomen*, contains the organs relating to digestion, as well as the kidneys and the organs of generation, these last, however, lying in the lower cavity of the abdomen formed by the hollow of the *pelvis* or *haunch*. The chest itself contains the lungs and heart, whilst through it passes the gullet or passage by means of which food is conveyed to the stomach. Having regard to the movements which the chest is called upon to perform in the act of breathing, we are not surprised to find that it is

composed of a series of bones, of which the chief characteristic is their elasticity. Later on, when the movements of breathing fall to be considered, it will be shown that this elasticity of the chest in a very marked manner contributes to the ease with which the acts of respiration are performed.

The walls of the chest are formed partly of bone and partly of *cartilage* or "gristle." Regarding the chest as a whole (Fig. 20), we find it is of conical shape. It is flattened from before backwards, its widest diameter being that from side to side. In front it is shorter than behind, and the spine projects into the chest in the middle line, thus forming two cavities or hollows, one on each side, and each occupied by a lung. The front of the chest is formed by the *sternum* (Fig. 20, 1 and 2), or "breastbone," and by the gristly or cartilaginous ends of so many of the ribs (Fig. 20, 11). The hinder wall of the chest and its sides are bounded by the twelve dorsal vertebræ and by the ribs. The ribs are obliquely set on the spine and connected to the breastbone, so that practically the upper end of the breastbone stands at the level of the lower edge of the second vertebræ of the back in men, and somewhat lower in women. One result of this difference in the conformation of the chest—a difference which has a certain effect on the types of breathing seen in the two sexes—is to give the neck apparently greater length in woman than in man. With respect to the general shape of the chest in the two sexes, that of woman is broader above than in man. With regard to its other dimensions, it is somewhat shorter than in the male sex. It may be added that the lowest ribs on each side aid in forming part of the upper boundary wall of the abdomen. The liver thus lies under the shelter of the lower ribs on the right side.

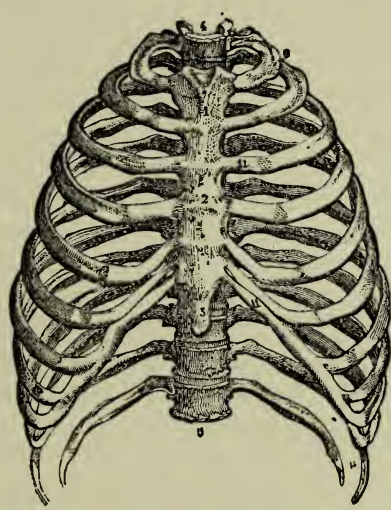


FIG. 20.—View of Chest or Thorax from the Front. 1 and 2, Breastbone; 3, Cartilage; 6, First Rib; 7, Second Rib; 9, False Ribs; 10, Floating Ribs; 11, Rib Cartilages.

The Breastbone.—The *sternum* or *breastbone* is a bone of flattened shape placed in the centre of the front wall of the chest, and possessing a broad upper end named the *manubrium*. It suggested to the ancient anatomists somewhat the shape of the short sword of the Roman soldier. Its upper and middle portion are bony

in structure, but its lower third is composed largely of cartilage, termed the *ensiform process* (Fig. 20, 3). At the sides of the breastbone are noted seven depressions which receive the gristly ends of the upper seven ribs, whilst at each side of the top of the breastbone is a surface to which the *clavicle* or collar-bone of that side is attached.

The Ribs.—The *ribs* themselves number twelve pairs, but it may be noted that occasionally an additional pair or pairs may be developed. These "supernumerary ribs" may be found attached either to the seventh vertebra of the neck or to the first vertebra of the loins. The upper seven ribs are frequently styled *true ribs*, for the reason that each is attached directly to the sternum by its own gristly end or *cartilage.* These gristly ends, it may be noted, are termed *costal cartilages* (Fig. 20, 11). The eighth, ninth, and tenth ribs on each side are termed *false ribs* (9). These ribs join the cartilage of the seventh, and are thus indirectly connected with the breastbone. The eleventh and twelfth pairs, starting, as do all the ribs, from the spine behind, fall short of the others, and are occasionally known as *free* or *floating ribs* (Fig. 20, 10). Each rib, given off from its vertebræ behind, presents us with the segment of a circle. Its "head" is the part by which it is attached to the body of the vertebra. As the rib curves, we find on it a small process or *tubercle*, designed to unite with the transverse process of the vertebra. As we proceed from the first rib, which is practically horizontal in position, we find the others presenting a downward slope and also an increase in their length, which attains its maximum in the eighth rib. From the ninth rib to the twelfth we find a diminution in size.

The Appendicular Skeleton.—The *appendicular skeleton* is the term applied to that giving support to the limbs. It may be first of all noted that in addition to the actual skeleton of the limbs themselves, this portion of our bony framework includes bones which give support to the limbs, and which attach the limbs to the body proper. Such bones are known as constituting in each case the *limb girdle.* These girdles in the human body are two in number, those of the *shoulder* giving support to the arms, and that of the *pelvis* or *haunch* giving attachment to the legs. Viewing Vertebrated animals as a whole, we find no member of this class presenting us with a greater number than four limbs, and these limbs are always developed in pairs.

The Type of Limb.—All Vertebrated animals, as already noted, are built up on a common type, and their limbs conform to the same arrangement witnessed in the body parts (Fig. 7). In the cases of fishes, those fins which exist in pairs correspond to the fore and hind

limbs of higher animals. In some Vertebrates the limbs are completely wanting. The case of snakes will occur to readers as an illustration of this latter fact; but it so happens that whilst in no snake do we find any trace of fore-limbs, in many of these reptiles we discover towards the hinder extremity of the body traces or rudiments of hind limbs. This latter fact indicates that existing snakes are probably the descendants of ancestors which were provided with legs. One pair of legs only may be developed, as in the whale tribe, where the fore-limbs alone exist and are converted into swimming paddles, whose skeleton exhibits precisely the same type (Fig. 7) seen in the arm of man or the foreleg of any other vertebrate animal. In the whales, it is interesting to note, may be found traces of hind limbs in the shape of rudiments of haunch bones and also of the thigh. Man, of course, possesses the normal development of two pairs of limbs. His upper limbs are modified to enable him to grasp objects, and to perform the countless operations connected with his special mode of existence. His hind limbs are employed for the purposes of locomotion only. The special structure of the foot and its conformation, as adapted to preserve easily the erect posture, will again be noticed when we arrive at the consideration of that portion of the skeleton.

The Upper Limb.—The *upper limb* or *arm* (see full length figure of skeleton) exhibits a division into five distinct portions. There is first of all—(1) the shoulder girdle, composed of two bones, the *scapula*, or *shoulder-blade*, and the *clavicle*, or *collar-bone*, with a rudiment of a third bone; (2) the upper arm, composed of a single bone, *humerus;* (3) the forearm, composed of two bones, *radius* and *ulna;* (4) the *carpus* or *wrist*, composed of eight bones; (5) the *metacarpus* or *palm*, composed of five bones, one for the support of each finger; (6) the *digits* or *fingers*, composed of small bones called *phalanges*, of which three exist in each finger, save the thumb, which possesses only two.

The Shoulder Girdle.—The chief bone of the "shoulder girdle" is the *scapula*, *shoulder-blade*, or *blade-bone* (Fig. 21) as it is sometimes named. This is a triangular bone which may be described as occupying a position at the back of the shoulder. Its inner surface is somewhat hollowed, and exhibits ridges and hollows corresponding to the ribs on which it reposes. When we look at the outer surface of the shoulder-blade we perceive a strong ridge of bone called the *spine* (Fig. 21, 10) of the scapula, which runs obliquely across its upper border. The end of this bony process projects to the outside of the shoulder, and, as it were, looks round its corner. This end is called the *acromion* process (Fig. 21, 12), and to it is attached the outer end of the *clavicle*, or *collar-bone* (see skeleton, 8), the

inner extremity of which we have already seen to be connected with the top of the sternum. The collar-bone is thus seen to lie along the front and upper portion of the chest. Immediately below the acromion process in which the spine or the scapula ends, is a shallow, saucer-like cavity, called the *glenoid cavity* (Fig. 21, 6). This last receives the rounded head of the upper-arm bone, or *humerus*, and it may readily be understood that as we have here a large rounded head moving in a shallow socket, we obtain that remarkable freedom of movement which characterises our shoulder-joint, and contributes to render the arm efficient for the many purposes to which it is applied.

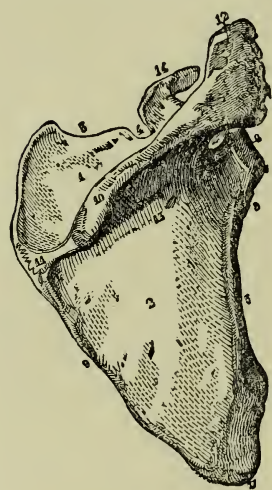


Fig. 21.—Scapula viewed from behind. 1, Upper Hollow or Fossa; 2, Under Hollow of Bone; 3, Superior Border; 4, Notch; 5, Border next Arm-pit; 6, Glenoid Cavity; 7, Inferior Angle; 8, Point of insertion of Triceps; 9, Spinal Border; 10, Edge of Spine of Scapula; 11, Smooth Surface over which Trapezius Muscle passes; 12, Acromion; 13, Hole or Foramen for Artery; 14, Coracoid Process.

To the inner side of this cavity, and lying also above it, we find another process, somewhat hook-shaped in conformation and called the *coracoid process* (Fig. 21, 14). This process has attached to it certain important muscles, and the collar-bone is also bound to it by strong cords or ligaments. But the chief interest which attaches to the "coracoid process" is the fact that it is developed as a separate bone. Furthermore, in lower forms of life, and notably in birds and reptiles, the coracoid process remains as a distinct bone throughout the whole life of these animals, and in birds assumes a very high importance, constituting in them a pillar-like bone which practically forms the chief support of the wing. We see therefore that in man a process of modification has taken place, converting an important bone in lower life into a mere process of the shoulder-blade. The general type of the shoulder common to all vertebrate animals is in this way duly demonstrated.

The Collar-Bone.—The *collar-bone* or *clavicle* (see plate of skeleton) is a narrow bone curved somewhat like an elongated letter "S," having, as we have seen, one end resting on the top of the sternum, and the other extremity attached to the scapula, as above described. Its breastbone end is thicker than that which is attached to the shoulder-blade. This is an important bone of the shoulder, seeing that it buttresses the shoulder outwards, keeping the arm well away from the wall of the chest and thus permitting of great freedom of movement. When the collar-bone is broken the shoulder is seen

to fall inwards and forwards, because in such an event the shoulder has been deprived of its buttress.

The Arm Proper.—The *upper arm* (see plate of skeleton) is composed of the first long bone we have had occasion to describe in the course of our observation of the skeleton. It is termed the *humerus*, and, like every other long bone, it presents to view a *head*, a *shaft* or *column*, and a lower extremity, or *condyles*. We have seen that the head of this bone reposes in the "glenoid cavity" of the shoulder-blade. Below, the humerus shows two surfaces or *condyles* (16), adapted for joining it to the two bones of the forearm; the inner of these surfaces resembles a pulley, and is called the *trochlea*. These pulley-like surfaces join the ulna (25) of the forearm, and when the two bones are interlocked we find thus formed the beautiful hinge arrangement characteristic of the elbow-joint. The other surface at the lower end of the humerus is called the *capitellum*, and by means of this latter projection it is attached to the radius bone (18) of the forearm.

To the humerus many important muscles connected with the movements of the arm are attached. An interesting observation has been noted in the fact, that from the inner of the condyles, or rounded surfaces seen below in the humerus, a ridge may be noted to be situated on the inner border of the bone. Occasionally in man a bony hook is found developed at this part, and the end of the hook is often attached to the bone by a band of fibres converting it into an aperture. Through this aperture an important nerve and an artery are found to pass. It is important to note that in certain animals, and particularly in the cat tribe, such an aperture is habitually found as a permanent and usual structure.

The Forearm.—In the skeleton of the forearm are included, first, the *radius*, and secondly, the *ulna* (Fig. 22). The radius (10) may be known by its rounded, pillar-like head. Below it expands into a broad extremity (15). The outer side of the humerus is attached to the radius by a distinct hollow, whilst it is also connected with its neighbour bone, the ulna. A sharp process, called the *styloid* process, projects from the outer side of the radius at the wrist. This process serves to give origin to an important ligament connected with the wrist joint.

The *ulna* (Fig. 22, 1) is a very different bone; it is easily distinguished by the fact that above it is deeply hollowed out (2), in order that the lower end of the humerus may be received by it, the junction of the two bones forming the essential feature of the elbow-joint. Behind the hollow is a bony process called the *olecranon*, and to this process is attached the *triceps* muscle. The olecranon may be easily

felt projecting when the elbow is bent. The ulna also possesses a *styloid process* below (8), and also shows a smooth surface for articulation with the radius.

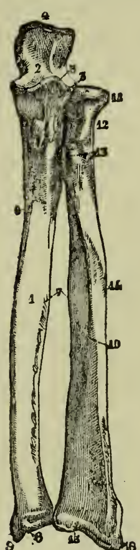


FIG. 22.—Bones of Left Forearm from the front. 1, Ulna; 2, Great Sigmoid Cavity; 3, Lesser Cavity; 4, Olecranon; 5, Coronoid Process; 6, Nutrient Foramen for Blood-vessels; 7, Space between Bone; 8, Head of Ulna; 9, Styloid Process; 10, Radius; 11, Head of Radius; 12, Neck; 13, Bicipital Tubercle; 14, Insertion of Primatur Muscle; 15, Lower end of Radius; 16, Styloid Process.

The "Turn of the Wrist."—It is of extreme importance to notice the relative position of these two bones, and also again to appreciate the fact that the radius is much broader below than the ulna. It has the wrist practically attached to it. In describing these bones it is necessary to note the position of the arm, which should be placed in what may be called the natural position with the palm of the hand lying upwards or forwards. The bones then lie side by side, the radius in this position lying to the thumb side of the forearm, and the ulna to that of the little finger.

It is obvious, however, that a very important movement of the arm consists in the turning of the palm downwards or backwards, this latter movement giving to the hand the power of performing actions which would be impossible of execution if the palm were permanently kept upwards or forwards. The act of reversing the hand is popularly described as a "*turn of the wrist.*" This is a somewhat misleading description of the movement which really takes place through the radius being made to revolve by means of its rounded head (Fig. 22, 11) around the lower extremity of the humerus and the ulna, a special muscular arrangement existing to effect this action.

As the radius thus revolves, it practically carries the wrist with it and also the hand. When the palm has thus been turned backwards or downwards the position of the two bones is naturally altered, for instead of lying side by side, as in the former case, the radius crosses the ulna (see right arm of skeleton figure). When the bones lie in their natural position, that is side by side, the arm is said to be in the position of *supination*. When, on the other hand, the palm is turned downwards, the position is described as being in that of *pronation*. In many animals, such as those which walk on the tips of their toes (lions, cats, dogs, &c.), the bones of the forearm are permanently fixed in the position of pronation.

The Hand.—We have already noted that the hand as developed in man presents itself as a highly human characteristic. An old writer expressed his belief that we should define the hand as an

exclusive human possession. This remark is utterly erroneous, for as all forelegs are constructed on a similar type, every vertebrate animal in one sense may be said to possess a "hand." The true mode of description of the human hand is that of styling man as the possessor of the most perfect hand. A monkey is capable of performing a great variety of actions by motions of its hands, but man excels all other animals in respect of the fact that his hand is capable of a greater variety of movements than is the hand in any lower form. In the hand we have to consider three regions, the *carpus* or *wrist* (Fig. 23, 1–8) forming the first of these. The wrist bones, called *carpal* bones, number eight in man. They may be described as existing in two rows of four each. One of these rows, that next the forearm, is composed of the following bones, beginning at the radius side, *scaphoid*, *semilunar*, *cuneiform* and *pisiform*. Those of the second row, beginning at the same side, are *trapezium*, *trapezoid*, *os magnum*, *unciform*. Of these bones the pisiform (4), by anatomists, is not regarded as a distinct bone, but appears to represent a bony formation developed in the sinew or tendon of a muscle. Sometimes a ninth bone occurs in the human wrist, this last representing a subdivision of certain other bones, whilst occasionally a ninth bone is found that appears to correspond with one occurring in the wrist of some monkeys and also in certain rodents or gnawing animals.

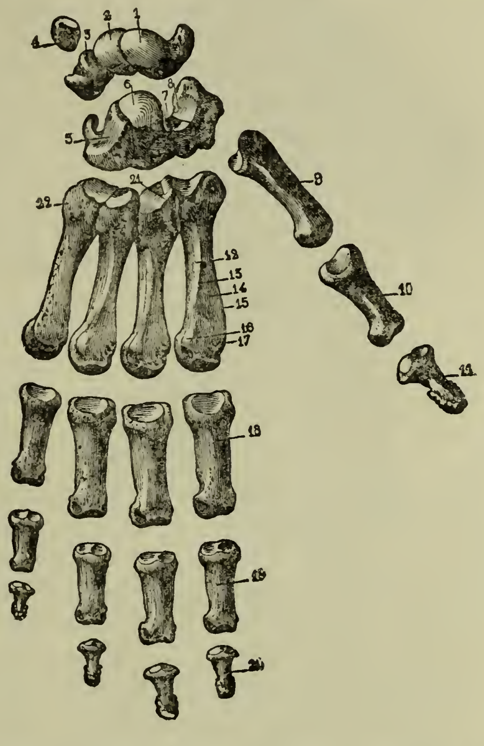


FIG. 23.—Bones of Hand and Wrist. 1, Scaphoid; 2, Semilunar; 3, Cuneiform; 4, Pisiform; 5, Unciform; 6, Os magnum; 7, Trapezoid; 8, Trapezium; 9, First Metacarpal; 10 and 11, Phalanges of Thumb; 12 to 17, Parts of a Metacarpal Bone; 18 to 20, Phalanges of Index finger; 21, Third Metacarpal; 22, Fourth Metacarpal.

The Palm.—The second segment of the hand is called the *metacarpus* or palm (Fig. 23, 9, and also 12–17, and 21 and 22). Here are found five bones, each supporting a finger. That of the thumb is much more movable than the others, whilst it is the shortest of the five.

The Fingers.—The *digits* or fingers present us with the highest number found in quadrupeds. We have already seen that they are composed of small bones called *phalanges* (Fig. 23, 10, 11, 18, 19, 20), and of the fourteen phalanges comprised in the hand the thumb possesses only two. In describing the bones of the finger, the *phalanx* joint or portion next the palm is termed number one, while the last or third bears the nail. This latter structure is represented in many lower animals by the "*hoof*"; that of the horse is simply an enormously developed nail, and is developed on the end of the single finger (the third) or toe, on which the animal walks.

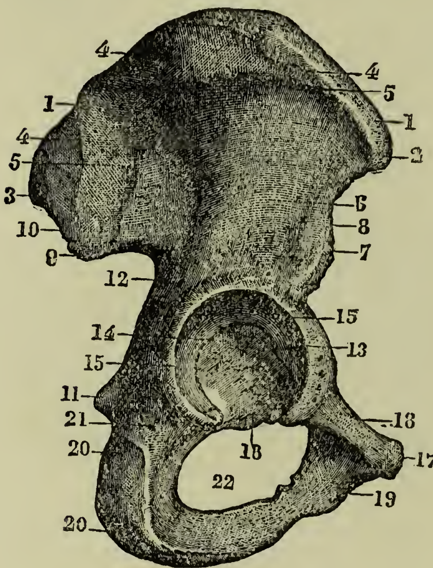


FIG. 24.—Haunch Bone from the Outside. 1, Border of Ilium; 2, Upper and Anterior Spine or Crest of Ilium; 3, Hinder and Superior Spine; 4, Superior Semicircular Line; 5, Middle Gluteal Line; 6, Insertion of Gluteus Minimus Muscle; 7, Anterior Inferior Spine; 8, Border between the Anterior Spines; 9, Inferior Posterior Spine; 10, Notch between Posterior Spines; 11, Spine of Ischium; 12, Great Sciatic Notch; 13, Acetabulum or Cavity of Hip-joint; 14, Interior of Cavity; 15, Circumference of Cavity; 16, Notch of Acetabulum; 17, Spine of Pubis; 18, Horizontal Ramus; 19, Body of Pubis; 20, Ischium; 21, Attachment of Muscle; 22, Thyroid or Obturator Foramen.

The Hand in General.—The hand of man, whilst resembling in type of structure that of every other vertebrate animal, owes its greater power to certain outstanding features whereby it has become modified for the special circumstances and wants of human existence. There is first of all extreme mobility of all its joints; in the second place, the thumb is invested with a special freedom of movement whereby it can be detached as it were from the other fingers and thrown into the middle of the hand so as to oppose its neighbour digits. Man can readily bring the tip of the thumb into contact with the tips of the other fingers, singly or together, and it is really this power, depending on special bony and muscular conformations, which gives to the human body the most perfect type of hand capable of executing both the roughest work and the finest and most delicate actions man is called upon to perform.

The Lower Limbs.—The *lower limbs*, as in the case of the upper limbs, we find attached to the trunk, each by means of its own special "girdle." This girdle in anatomical language is termed the *pelvic girdle.* Popularly it may be described as the *haunch.* A certain

broad resemblance is easily distinguishable between the conformation of the skeleton of the upper and lower limbs. If the two limbs be placed together, the eye readily detects that the shoulder would correspond with the haunch, the thigh with the upper arm, the leg with the forearm, the wrist with the ankle, the instep with the palm, and the toes with the fingers. This likeness has not escaped the notice of anatomists, and it is probable that the explanation of this uniformity of structure may be found in the view that both limbs have been developed out of a common type.

The Pelvis. — The haunch or *pelvis* itself (see skeleton plate) is formed, first, of two haunch bones known as the *innominate bones*. In front, these are joined to form the *pubis*. Behind, we find wedged in between them the lower portion of the spine constituting the *sacrum* (22), to the end of which last, as we have seen, the *coccyx* or "tail" is attached. Regarded from this point of view, it may therefore be assumed that the pelvis consists of eleven bones, viz., five in the sacrum, four in the coccyx, and the two haunch bones.

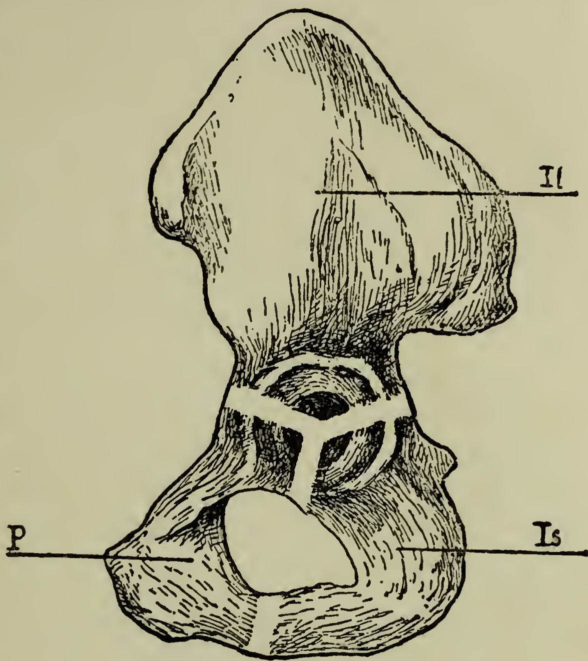


Fig. 25.—Haunch Bone of Child, showing the Point of Union of the three Bones, Ischium (Is), Ilium (Il), and Pubis (P), in the Acetabulum or Hip-joint Hollow.

In reality, however, a larger number of bones exist in the pelvis. The innominate bones consist of three distinct bones, respectively known as the *ilium* (Figs. 24, 1 and 25, Il), *ischium* (28), and *pubis* (26). In the adult with a fully formed skeleton, no trace of the threefold nature of the haunch bone is perceptible, but if this bone in the child be examined (Fig. 25), the line of union of the three bones can be easily distinguished. The point of union of the three exists in the socket or *acetabulum*, which receives the head of the thigh-bone to form the hip-joint. In reality, therefore, we find the pelvis to be composed of no fewer than fifteen bones.

Each haunch bone (Fig. 24) presents us with an irregular shape. It joins its neighbour in front. It forms the sides of the pelvis and also part of the back portion of this basin-shaped cavity, where these bones have the sacrum wedged in between them, thus constituting an extremely solid bony girdle forming a secure attachment for the limbs. It may be added that it is not until the twenty-fourth or twenty-fifth year of life that the three bones composing each haunch bone become firmly united. Having regard to the threefold composition of the haunch bone, its parts have received names corresponding to those of its original elements. The *ilium* (Fig. 24, 1) is thus the expanded part which forms the outer and upper ridge, easily felt on each side of the haunch. This bone contributes most largely to the conformation of the basin or hollow of the pelvis. The lower portion of each haunch bone is called the *ischium* (20). This part supports the body in the sitting position. The third portion lies above and in front. This is the *pubis* (19), and unites with the corresponding bone of the opposite side in front.

On the outer side of each haunch bone is a deep cavity called the *acetabulum* (14). It is here the three bones, as we have seen, unite. This deep hollow receives the head of the thigh-bone. Between the ischium and the pubis in each haunch bone is found a distinct opening called the *thyroid foramen* (22). In life this aperture is closed by a membrane.

The Haunch in the Sexes.—The importance of the pelvis is obvious when we consider that it contains the organs of generation, and likewise the bladder, with other structures, including the termination of the bowel. As has already been remarked, the pelvis of woman is broader and wider than that of man, whilst the arch of the pubis is also wider; these features having reference to processes connected with the birth of the child. In woman the bones are of a more slender character, the greater expansion and spreading nature of the ilium on each side giving greater breadth to the hips of the female sex.

THE LOWER LIMB

The Thigh-Bone.—The first segment of the lower limb is constituted by the *femur* or "thigh-bone" (see skeleton plate and also Fig. 33), which is the longest bone in the body. In general type it presents a distinct resemblance to the humerus of the upper arm. In it, as in the latter bone, we find a "head," a "shaft," and "condyles" below. It articulates above, as we have seen, with the haunch; below its rounded condyles rest on the flat head of the *tibia* or "shin-bone"

(34), thus forming the knee-joint. The head of the femur is seen to be supported on a distinct neck, whilst at the upper end is also seen a very strong prominent process, called the *great trochanter* (27). This process can easily be felt at the outside of the hip-joint. It gives attachment to certain very important muscles connected with the hip itself. Below, the thigh-bone has its extremity divided by a notch separating the bone behind into the two condyles, of which the inner one is longer and narrower than the outer. These condyles practically form the hinge of the knee-joint.

The Knee-Cap.—In front of the thigh-bone below we see a smooth surface of grooved character; it is over this surface that the knee-cap moves in the motions of the knee-joints. Placed in front of this joint we find this latter bone, called the *patella* (Fig. 26). This bone is triangular in shape and of flattened conformation; it serves to protect the front of the joint, being united to the shin-bone below by a distinct ligament. It is interesting to note that this bone is not to be regarded as a distinct element of the skeleton, for the reason that it is not developed in the same fashion as the other bones of the skeleton. It is, in fact, a bony formation which appears in the *sinew* or *tendon* of the great *extensor muscles* which form the fleshy part of the front of the thigh, and whose duty it is to straighten the leg. Bones of this kind are known as *sesamoid bones*. We find illustrations of this kind of bone elsewhere in the body. They are sometimes developed in the sinews or tendons which are found on the upper surface of the fingers and toes, and which belong to the extensor muscles of these parts, straightening the toes and fingers respectively. Another interesting illustration of sesamoid bones is that found in the case of the kangaroos and their neighbours. As is well known, the mother kangaroo protects her young for a certain period after birth within a pouch situated in the front of her body. This pouch is supported on two bones known as *marsupial bones*. These bones rise from the front of the pelvis or haunch of the animal. In their nature they correspond to our own knee-cap, for, being sesamoid bones, they are developed in the sinews or tendons of the muscles of the front of the animal's body.

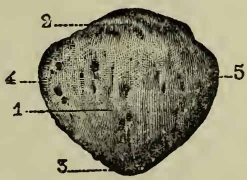


FIG. 26.—Knee-Cap seen from the Front. 1, Anterior Face; 2, Base; 3, Point of Bone; 4, Outside, and 5, Inside Border.

The Leg.—The "leg" may be defined as that portion of the lower limb extending from the knee-joint above to the ankle below. Most persons are aware that two bones exist in the former (radius and ulna), but the fact that two bones exist in the leg often escapes popular notice, for the reason that one of these bones, lying at the outer side of the leg,

is somewhat inconspicuous, and is not readily felt through the muscles of this portion of the body. The two bones of the leg are respectively the *tibia* or *shin-bone*, and its neighbour the *fibula* (Fig. 27). It is characteristic that this latter bone has no common name, a feature we find represented in the case of parts or structures which lie somewhat without the recognition of popular knowledge. If the fibula is an inconspicuous bone, the opposite holds true of its neighbour the *tibia*. The sharp bony ridge of this latter bone, which lies close to the surface of the leg, frequently receives contusions resulting in that highly painful accident, an injured shin.

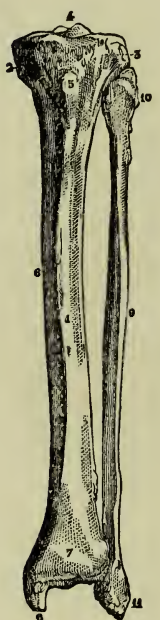


Fig. 27.—Front View of Leg Bones (Left Leg). 1, Tibia; 2, Internal Tuberosity; 3, Outer Tuberosity; 4, Spine of Tibia; 5, Anterior Tuberosity; 6, Crest of Tibia; 7, Lower End; 8, Malleolus of Tibia; 9, Fibula; 10, Upper Extremity; 11, Outer or External Malleolus of Fibula.

The Tibia.—Dealing first with the tibia (1), we find this bone to present us with a very broad head divided into two shallow depressions which receive the two condyles of the thigh-bone. In front of this head-end is a distinct surface, to which the ligament of the knee-cap is attached. The bone possesses a sharp ridge, marking its front surface. Below, the tibia is hollowed, in order that it may move smoothly on the upper surface of the particular bone of the ankle with which it articulates to form the ankle-joint. At the lower end of this bone its inner side possesses a very distinct projection, which in the natural position of matters covers the ankle so far. It is this lower projection of the tibia, called the *internal malleolus* (8), which is felt projecting on the inner side of the ankle.

The Fibula.—The fibula (9), its companion bone, lying to the outside of the leg, is a slender bone. By its upper end it is joined to the shin-bone. Below there is a very distinct process called the *external malleolus* (11). This projects below the corresponding projection on the shin-bone, and forms a protection for the ankle-joint on the outside of the foot. In connection with this lower end of the fibula, an interesting point is found in the fact that the accident popularly termed "a broken ankle" in reality represents a detachment of the fibula's lower end from its shaft. This accident is liable to occur when from one cause or another the foot doubles under, the strain causing the bone to give way. We see that the ankle is not really involved at all in such an occurrence. The proper name of the accident is "Pott's fracture." It was so named after the distinguished London surgeon who first accurately described the symptoms and treatment of this lesion.

The Ankle.—The *tarsus* or *ankle* (Fig. 28, A and B) consists of seven bones arranged like those of the wrist in two rows. The hindmost row, or that next to the leg, consists of the *astragalus*, *os calcis* or *calcaneum*, and *scaphoid* (*a*, *b*, *c*); the second row contains the *cuboid* (1), lying to the outer side, and three *cuneiform bones* (2, 3, 4). It is the os calcis which projects to form the heel. It has already been noted as a distinct human character that in man, having regard to the size of the foot, the heel projects much further behind the foot than is the case with the heel of other animals. The os calcis, therefore, forms an important fulcrum, on which the body is easily supported in the erect position. Lying above the heel bone is the *astragalus*, which may be known by its beautiful rounded surface above, on which the lower end of the shin-bone moves to form the ankle-joint. The scaphoid bone lies in front of the astragalus, whilst in front of this latter in turn come the three cuneiform bones. The cuboid bone (1) lies to the outer edge of the foot between the heel bone and the instep.

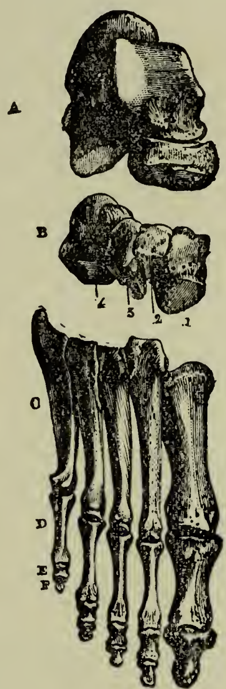


Fig. 28.—Bones of Ankle and Foot from the Front. A and B, First and Second Rows of Ankle Bones; *a*, Astragalus; *b*, Calcaneum; *c*, Scaphoid; 1, Cuboid; 2, 3, 4, Cuneiform Bones; C, Metatarsus; D, E, F, Phalanges.

The Instep.—The *metatarsal bones* (C), five in number, form the instep; the largest of these bones is that supporting the big toe. Finally, the *digits* or *toes* show the same number of *phalanges* or small bones (D, E, F) in their composition as the fingers, the great toe possessing two only, and the other toes three each.

The Foot at Large. — Considering the foot generally, we find that it presents us with a double arch; the first arch runs from before backwards, and has the heel as one of its piers and the balls of the toes as the other. The second arch passes across the foot, and thus gives to this portion of the body not merely a large amount of elasticity, but also endows it with firmness in order to enable it successfully and easily to sustain the weight of the body, which is transmitted to it directly through the shin-bones. These last rest on the crown of the arch formed by the astragalus, as already described.

Deformities of the feet are readily brought about, especially in the young state, by the carelessness of mothers in neglecting to see

that the feet of their children are provided with boots or shoes of natural and easy conformation. Later on in life a considerable amount of foot distortion is caused by the practice of wearing boots which are not moulded properly to the form of the feet—the result being that deformity, not merely of the instep, but of the toes, is brought about. When the beautiful ligaments which bind the various bones of the arch of the foot together are subjected to undue strain, a tendency exists for the arch to sink so that the condition known as *flat foot* is produced. This latter state is often an extremely painful one, and renders the movements of walking in a natural fashion impossible of being executed.

Human Feet and Others.—The difference between the foot of man and that of the apes may now be realised. Man has no power of throwing his great toe like his thumb out of the general plane of the other toes. He cannot, in other words, oppose the great toe to the other digits as is the case in his hand. The monkey tribe are capable of performing this action, hence the great toe, acting with them as a thumb, enables the foot to be used for prehension or grasping. In this way the feet become "hands," although it must be carefully noted that when we so describe the feet of the ape we merely mean to imply that it is the foot which is hand-like, and not that the foot exhibits the essential structure of the real hand.

JOINTS

A joint, otherwise known as an *articulation*, may be described as a movable surface or surfaces existing between two or more bones. Certain joints are relatively simple in their nature. The shoulder-joint for example, which consists of the junction of the humerus with the glenoid cavity of the shoulder-blade illustrates an articulation in which two bones are alone concerned. In the case of the hip-joint (Fig. 29) we find practically a similar condition of matters; the head of the thigh-bone working in the socket of each haunch bone, which although composed of three bones in early life is nevertheless essentially a single bone in the adult. The case of the wrist-joint and ankle-joint introduces us to greater complexities of structure, while the fingers and toes on the other hand bring us back to joints of a simpler character.

Varieties of Joints.—Looked at from another point of view, anatomists have classified joints according to the amount of freedom of movement which takes place between them. A classification of joints according to this latter method may therefore be founded on

the terms *movable* and *immovable joints.* An illustration of immovable joints has already been given in the case of the articulations or joints between the bones of the skull, that between the skull and the lower jaw of course being excepted. A suture, already described, where the edge of one bone dovetails into the edge of the other by toothed processes, practically exemplifies what is meant by an immovable joint. Beyond this state, where there is practically no movement at all permissible between bones, we find joints which confer on the parts in which they are found flexibility rather than any power of distinct movement. We find this second variety of joint extremely represented in the case of the spine.

Fig. 29.—Hip-joint opened, showing Head of Thigh-Bone retained in Socket by the round Ligament.

There are interposed between the bodies of the different vertebræ plates of gristle or cartilage, known as *intervertebral discs.* These plates of cartilage, firmly placed between the vertebræ, are kept in position by strong ligaments. As cartilage is in its nature an elastic substance it can readily be seen that the interposition of such masses between rigid bony structures will confer upon the spine a flexibility, without conferring on it any distinct or separate movement of its component parts. Hence it is that we are able to bend our back, and also to exercise certain movements not merely of a forward and backward description, but also of a lateral kind as well. Lower down in the spine we find similar joints between the sacrum and the coccyx, between the two haunch bones in front, and between the sacrum and the two haunch bones.

An interesting observation in connection with the series of joints represented in the spine has been made to the effect that a man is really a fraction taller on rising from his bed in the morning than he was at night. This result is due to the fact that whilst during the day, in the erect position and in the movements of walking, as well as on account of the weight of the body, the discs of cartilage between the bodies of the vertebræ are compressed, at night, in consequence of the recumbent position, these discs regain somewhat of their elasticity and slightly expand. The additional height thus conferred is of course merely fractional in its nature.

Movable Joints.—Turning to the second variety of joints, those of the *movable* description, we come to consider articulations, which correspond to the popular idea of a joint. Here we find a range

of movement varying materially in its amount. In some cases the movement is of an extremely free description, in others it is more or less limited. The difference between one joint and another depends naturally upon the exact relations between the bones of which it is composed. Considering these joints as a whole we find certain definite structures entering into the composition of them all. These structures include first, *bones;* second, we find covering the ends of bones in joints a particularly delicate description of gristle or cartilage. This is known as *articular cartilage*, which differs materially in its nature and construction from the cartilage we have already described in other regions of the body, such as that for example forming the ends of ribs and constituting the front wall of the chest.

Joint Structures.—A familiar illustration of the cartilage found in joints is afforded by a glance at the knuckle bone in a joint of meat which the butcher has turned out of its socket. The end of the bone is seen to be covered with a smooth delicate layer of a bluish white or pinky white colour. This is the articular cartilage, and with a knife it may be sliced off until the bone itself is reached. A third element found in connection with joints is that known as *ligaments* (Fig. 29). These represent the stout cords which bind bones together. They are formed of a very strong variety of fibrous tissue, and it takes very considerable force to detach them from the bones they keep in position. What is known as a "sprain" really consists in a rupture or straining of the ligaments of the joint. It is a perfectly true remark that in many instances a sprain is much more difficult of repair than a simple break of bone. The fourth structure present in joints is a special membrane known by the name of *synovial membrane.* This membrane lines the cavity of joints, and it is also found constituting sheaths placed between the tendons and bones in situations where there is much friction. The use of this membrane is that of lubricating or oiling a joint. It manufactures a special secretion of an oily or glairy nature resembling white of egg. This substance acts as a lubricator, and therefore in the mechanism of the human body the synovial membrane may be compared to the oil-can of an engineer.

Bursæ.—The fifth structure associated with a joint is known as a *bursa.* Bursæ do not occur in all joints, but they are specially found wherever a large amount of friction exists. Each bursa may be described as a small pad covered with synovial membrane which is responsible for the providing of lubricating matter. An excellent illustration of bursæ may be obtained from a consideration of the

knee-joint. In the act of walking it is obvious that the knee-cap in its movements must entail a considerable amount of friction not merely between itself and the skin covering it, but also between itself and the bony structures which lie below. We therefore find that nature interposes between the surface of the knee-joint and the inner surface of the knee-cap a bursa, over which the knee-cap moves smoothly. We find also that to limit friction between the knee-cap and the skin above it another bursa is interposed, so that the knee-cap may practically be said to move between two rollers, or "ball bearings."

In connection with the bursa placed between the knee-cap and the skin it may be mentioned that inflammation of this structure constitutes the disease popularly known as "housemaid's knee." This ailment is liable to be produced through servants kneeling upon hard floors whilst engaged in scrubbing operations. In other situations of the body bursæ are found. There is one for example placed over the elbow, and other and smaller bursæ exist in the case of the knuckles.

We have already described the great process of the thigh-bone, called the "trochanter" (see skeleton plate, 27), which forms the outer prominence of the hip. Here also bursæ are found enabling the great hip muscles to move easily over the bony prominences in the act of walking.

Varieties of Joints.—The "movable" joints may be classified according to a fourfold division, each group distinguished by the particular kind of movement it exhibits. The most common joints of the body are those termed *hinge joints.* This description is accurate enough, seeing that for the most part such joints in their movements resemble those of a door. The motion takes place in one direction only. The elbow-joint forms an interesting example of this variety of articulation, as also do the knee, the wrist, the ankle, and the joints of fingers and toes. A characteristic of this joint is found in the fact that the ligaments which bind them together at the sides are of extremely strong nature, and do not permit of much side movement.

Ball and Socket Joints.—A different character of joint is that termed a *ball and socket* joint. This variety would be termed by a mechanic a "ball" or "universal" joint. We see illustrations of such joints very typically represented in the shoulder and hip (Fig. 29). The round head of one bone is received into the socket formed, borne on another bone. Movement here takes place in all directions, and may be described of a kind termed *rotatory.* In such joints we find

the head retained within the socket by means of a strong *round ligament* (Fig. 29), whilst by way of further keeping the head of the bone in its position, the whole joint is surrounded by a fibrous membrane forming what is called the *capsule of the joint.* Such joints are more liable to be dislocated by a moderate amount of force than hinged joints. With respect to their range of movement it will be readily understood that the shallower the socket the freer and the more extensive the motions. The shoulder-joint exhibits a far greater range of movement than the hip, because its socket is practically a shallow saucer, while in the case of the hip the head of the thigh-bone fits more accurately into what is practically a deep cup (Fig. 24, 14).

Pivot Joints.—A third description of joint is that which is known as a pivot joint. As indicated by this name we find movement of this articulation taking place round a fixed point. An illustration of this joint will readily occur to the mind in the shape of the articulation between the head and neck. It has been shown that the head and the first vertebra or *atlas* (which is attached to the skull) together move upon a bony peg called the *odontoid process*, which springs from the body of the *axis* or second vertebræ. This peg forms the pivot on which the head rotates. Another illustration of this variety of joint is found in the case of the radius and ulna (Fig. 22). When the hand is turned, as has already been shown, this result is attained by the round head of the radius rotating around the fixed point formed by the ulna, a special ring-like ligament keeping the head of the radius in its place as it moves.

Finally there are certain joints to which the name of *gliding joints* has been given. The movement here is a slight and limited sliding movement of one bone upon another. The collar-bone at its attachment to the breastbone exhibits motion of this kind, also a similar movement takes place between the various bones of the wrist and between those of the ankle.

THE STRUCTURE AND DEVELOPMENT OF BONE

If we analyse a bone we find it to be composed of two distinct elements. The first of these may be described as consisting of *animal matter*, and the second of *mineral matter*. The animal matter of bone consists of *gelatin*, the mineral matter chiefly of *phosphate of lime*. These two elements are intimately united in the bone. They differ in their proportions, there existing about one-

third of animal matter to two-thirds of mineral substance. A table of the composition of bones shows us the following proportions :—

Animal matter . . .	33 per cent.
Mineral matter, including— Phosphate of Lime, Carbonate of Lime, Fluoride of Lime, Phosphate of Ammonium, Chloride of Sodium, &c.	67 per cent.
Total .	100

It may be noted that in early life the animal matter exists in greater proportion than in adult life. A result of this feature in bone development is seen in the fact that bones in children will bend instead of breaking. In old persons, by the absorption of the animal matter leaving a greater proportion of mineral matter, the bones become brittle, and are therefore singularly liable to be fractured.

The Analysis of a Bone.—A popular method of demonstrating this double composition of bone is that of boiling or burning a bone when the animal matter or gelatin is removed from it, leaving the bone substance white and limy-looking by reason of its containing mineral matters only. If, on the other hand, we soak a bone in a dilute acid for some time, the acid will remove or burn away the mineral matter without interfering with the gelatin. In the latter case the bone will retain its original shape, but it will have become so flexible that it may be bent in any direction or even tied in a knot. Bone itself is an extremely strong structure, and it has been said that bulk for bulk a cube of solid bone will resist a greater amount of pressure than solid oak.

Bone-Formation.—It is interesting to notice the process by which bone is formed. The long bones of the body are pre-formed or moulded, to begin with, in *cartilage* (Fig. 30, 1). The flat bones of the body, on the other hand, are laid down in the material called *white fibrous tissue.* It is a particular variety of cartilage which forms the *matrix* or mother substance of bone ; this substance is called *hyaline cartilage.* It consists of a certain base of a somewhat glassy appearance, which under the microscope is seen to contain numerous minute bodies known as *cartilage cells.* It would appear that the essential nature of the process of bone-formation is not that involved in the deposition of limy material derived from the blood, and of the conversion of gristle in this way into mineral matter. The process seems to be actually due to the appearance of living cells in the cartilage

called *osteoblasts*, whilst at the same time blood-vessels begin to be developed within the cartilaginous substance (Fig. 30). The canal of a long bone (Fig. 33, M) is filled with *marrow*, a substance which appears to discharge certain important functions in connection with the formation of red blood corpuscles. Marrow itself in composition resembles fat.

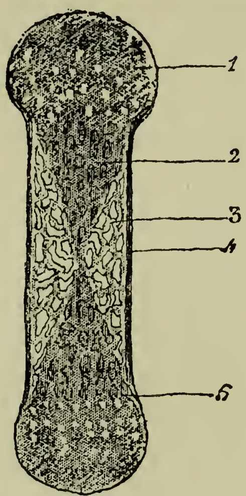


FIG. 30.—Plan of Ossification of a Bone. 1, Cartilage; 2, Cartilage-formed Bone; 3, Bone formed by Periosteum; 4, Periosteum; 5, Line of Bone-formation.

Bone under the Microscope.—It is not necessary here to enter fully into the technical description of the growth of bone out of cartilage. Suffice it to say that at the conclusion of the process a very different structure in the shape of true bone offers itself for consideration. If a cross section be made of a piece of bone, and this be rubbed down so fine that the light can be reflected through it, the microscope enables us to perceive a definite structure. The bone substance is then noted to exhibit a vast number of tubes (Fig. 31, 1), the ends of which in cross section appear as rounded apertures. These are called *Haversian canals* (Fig. 32, 1). Their duty is to carry the blood-vessels of the bone, for it must not be forgotten that bone, usually regarded as a dense dead structure, is beautifully supplied with blood for the purpose of growth and nourishment. Around the *Haversian canals* we find the bone substance arranged in concentric rings (2). Imbedded in these rings are irregular receptacles called *lacunæ* (3). Each of these is practically a little hollow or lake, and fine lines, which are really minute canals called *canaliculi* (4), are seen to pass from one lacuna to another. The picture thus presented to us of a section of bone resembles somewhat the map of a country full of lakes communicating with one another by means of fine rills or brooks. In the lacunæ we find in a living bone the *bone cells*, each of which is a microscopic mass of *protoplasm* or living matter, and the canaliculi carry threads of this living matter, placing one cell of the bone in connection with the others. Bone is thus seen to be essentially a living structure, and it is upon these bone cells that the duties of bone growth and bone repair devolve. The

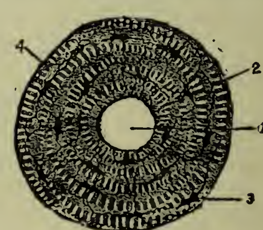


FIG. 31.—Microscopic Cross Section of a Minute Portion of Bone showing (1) Haversian Canal, (2) Bone Lamellæ or Layers, (3) Bone Cells in Lacunæ, and (4) Canaliculi.

blood supplied to the bone is intended for the nourishment of these living units of the structure.

Growth of a Bone.—With reference to the growth of bone, we note that in the case of a long bone its formation takes place from distinct points, which are termed *centres of ossification.* In a long bone we ordinarily find centres for the development of the shaft and ends respectively. Each centre of ossification contributes to the formation of its own part of the bone, so that when the bone has attained a certain development we find its outline completed. Its substance is bony, but its ends are not firmly united by osseous substance to the shaft. These ends are called by anatomists *epiphyses* (Fig. 33, C, C[1]). If an injury is received by the bone at this stage it can readily be understood that the end may very readily be separated from the shaft. If the parts are properly adjusted this accident may be regarded as of a trivial character; whereas if such adjustment is not effected serious bone deformity may result.

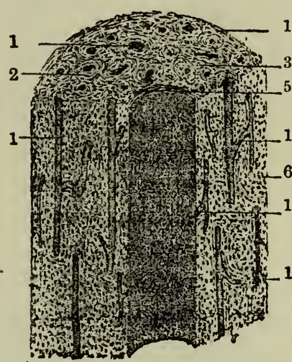


Fig. 32.—A Bone in Longitudinal Section showing Haversian Canals, 1 and 2; Bone Substance and Lacunæ, 3 and 4; the Medullary Canal, 5; and Osteoblasts, 6.

The further growth of the bone necessary in order to bring it to its full development and length occurs not in the shaft but at its ends. It is in the region separating the end from the shaft that new growths appear, and the two ends gradually come to be pushed further and further apart by such new formation until the proper dimensions of the bone are attained. A long bone thus grows not in the middle but at its ends.

With reference to the growth of the bone in thickness, another process has to be taken into consideration. Covering a living bone we find a tough membrane which receives the name of the *periosteum* (Fig. 33, P) or "bone sheath." This membrane was formerly believed to be simply useful for purposes of protecting the bone, and for giving support to the blood-vessels which enter it. It is now known that the periosteum, on the other hand, is the great factor to which an increase of the bone in thickness is due. Its inner surface is specially provided with these important cells, called "osteoblasts," or bone-forming cells, already noted as taking part in the formation of bone substance. Layer by layer of bone is thus added to the outside of the shaft, bringing the structure up to its required thickness. The great importance of the periosteum in connection with bone is not limited to its work in

giving the bones their adequate degree of thickness. It is intimately concerned with the repair of bones when broken, and also with the renewal of portions of bones which may have been destroyed by disease.

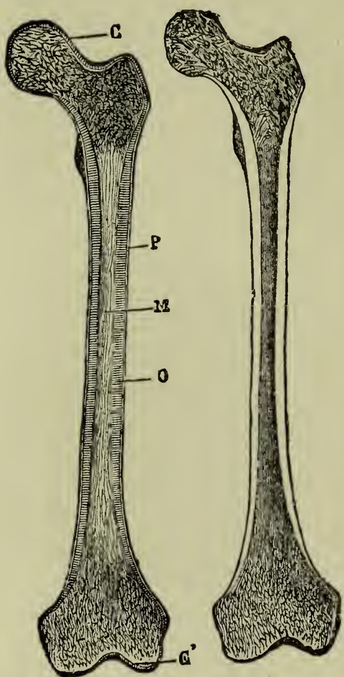


FIG. 33.—Long Sections of Thigh-Bones. The Right-Hand Figure is that of a Dry Bone, a Fresh Bone being shown on the Left. C C^1, Epiphyses; O, Shaft; P, Periosteum; M, Marrow.

Bone Repair. — An interesting fact has been chronicled in the shape of the observation that if a portion of periosteum with its living cells be placed in some other part of a living body it will there continue its bone-forming functions. Still more typically is the power of the periosteum exhibited in the domain of the surgeon. In consequence of an injury a portion of a bone may die, its nutrition having been interfered with. The dead portion is known as the *sequestrum*, and the disease itself as *necrosis*. In olden times surgeons were accustomed to regard this partial death of a bone as an occurrence which often necessitated removal of a limb by way of saving life. Through the discoveries of the late Professor Syme of Edinburgh, and others, it was shown that all that was required on the part of the surgeon was the removal of the dead portion. If the periosteum was intact it was found to be perfectly capable of fully replacing by new bone the lost or injured part. So successfully does it accomplish this work that very large masses of bone are capable of being restored by new growths, and the lower jaw itself, removed for disease, has been, through the work of the periosteum, practically replaced.

MUSCLES AND MOVEMENTS

The power of movement constitutes one of the particular features of all living beings, this remark applying both to the animal and to the plant worlds. In the vast majority of animals the movements executed are of very obvious character. Motions which have for their object the propulsion of a body through the air, in the water, or along the surface of the earth, are characteristic enough of the

animal world. Some lower forms of plant life also possess definite powers of movement, and are capable of swimming freely in the water in which they live, whilst other forms of plants may even exhibit crawling movements. In the case of higher plants we may find definite movements of certain parts exhibited, as, for example, in the case of the "Venus' Flytrap," which closes its leaves in order to capture insect prey, or in the "Sensitive Plant," which droops its leaves on the slightest touch. But even in plants in which ordinary movements appear to be conspicuous by their absence, we may find definite proof that they are not exempt from the law that motion is characteristic of all forms of vitality. Movements of the protoplasm, or living matter contained in the cells of a leaf, can be detected by aid of the microscope; and if we have regard to the circulation of sap in plants we again come face to face with another kind of motion essential for the nourishment of the living being.

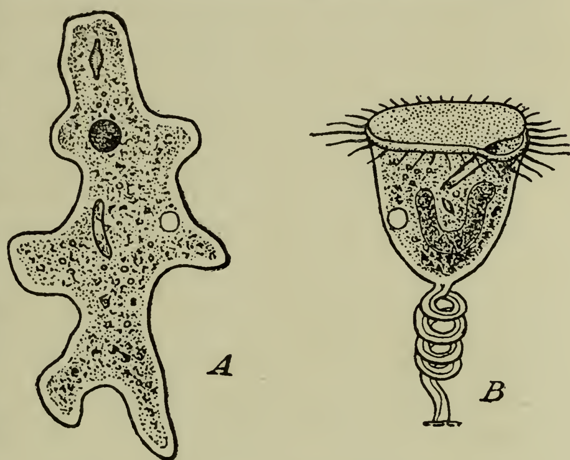


FIG. 34.—*A*, an *Amœba* (highly magnified), a low Animal composed of a minute mass of Protoplasm; *B*, an Infusorian Animalcule showing movement of coiling on its Stalk.

Movement in Animals.—It is, however, in the animal world that the movement as a function of life is most typically witnessed. If we take certain of the lowest organisms (Fig. 34), whose bodies consist each of a speck of protoplasm or living matter, we find such lowly forms of life to exhibit very definite powers of movement. Living matter is capable of contracting and expanding, and it is through movements of this kind that low forms of animalcules (*A*) are enabled to capture their prey by throwing the soft substance of their bodies around the particles they have captured. If movement be thus a characteristic feature of living matter, we need not be surprised to find that in higher forms of existence the same living substance forms the essential part of *muscles*, and endows these structures with the capability of executing all the varied motions incidental to animal existence.

What Muscle is.—We therefore move by means of our muscles. Roughly considered, muscles move the bones to which they are attached, and in this way convert the bones of the skeleton into a

series of levers. Muscle is the *flesh* of the animal body. What we eat in the fish is its muscle; the mutton chop represents the muscle of the sheep, and beef is the muscle of the ox. Our own flesh, therefore, constitutes what anatomists term the *muscular system of the body.*

It is most important to glance here at the different functions which muscle may be said to perform in our body as in the bodies of lower forms of life. Naturally all these duties resolve themselves into a question of movement; but the movements are of very varied character, and are necessarily devoted to very different ends.

What Muscles do.—In the first place, by means of muscle or muscular tissue, we execute all our ordinary movements, such as those of walking, leaping, grasping, and the rest. In the second place, our blood is circulated by means of muscular action; for the heart may be described truly and simply as a hollow muscle, and we also find blood-vessels to be provided with a delicate layer of muscular tissue. In the third place, we breathe by means of muscular action, this latter being directed to the enlargement of the chest. In the fourth place, digestion is largely carried out through movements of the muscular layers of the digestive tube. Food is masticated or chewed by the same means—namely, the muscular action of the jaws; it is swallowed through a similar action on the part of the mouth and gullet; it is moved about in the stomach through the action of the muscular coat of that organ, and it is finally propelled through the intestine or bowel by a similar agency. In the fifth place, by means of muscles we are enabled to execute those movements of lips, tongue, and other parts of the mouth concerned with the production of speech, and it may be added that "the expression of the emotions" is also largely carried out through muscular action. Thus when a man shrugs his shoulders, and thereby expresses indifference or contempt, he is employing the action of particular muscles for a particular end in the way of mental expression.

The number of muscles in the body has been estimated at about four hundred. Each of these muscles constitutes by itself a distinct organ, and is separated from its neighbour muscles by means of a layer of fibrous tissue known as *fascia*. With regard to the proportion of the weight of the body constituted by the muscular system, it is generally reckoned they represent about two-fifths of the whole weight. In a person weighing say 150 lbs., the muscles would be found to constitute about 60 lbs. of this amount.

The fact that each muscle is practically an organ distinct from its neighbours can in a rough way be seen by looking at the section of these organs in a slice of cold roast beef. In such a view of matters we can see the boundaries between the muscles which have

been cut across by the carving-knife, and we may also be able in such a section to see the bundles of fibres forming the constituent parts of the muscle itself (Fig. 36).

The Structure of Muscle.—A better understanding of the arrangement of the muscular system is of course gained from viewing the representation of a dissection of any part of the body. We see the separate nature of the muscles in a superficial dissection of the head and neck, and such a view of this region of the body will give an admirable notion of the many distinct and separate muscles which may enter into the formation of a particular bodily region. In the same way the dissection of the muscles of the arm would demonstrate the same truth and show the distinct boundary lines between one muscle and another. There are of course different layers of muscles in almost every region of the body.

Any ordinary muscle will be found to consist of two distinct parts. There is first of all the truly muscular or fleshy part called the *belly* of the muscle. At each extremity we see a different structure by which the "belly" is attached to the respective bones it is intended to move. These attachments are called *tendons*, or popularly, *sinews*, and they have been well described as the ropes by which the muscle itself is attached to the bones. A popular view of sinews or tendons may be had by looking at the back of the hand. On moving the fingers the tendons may be perceived as cords representing the sinews of the muscles of the upper surface of the forearm, by the action of which the fingers are straightened or extended. The reason why a muscle is attached to bone by tendons instead of by its own fleshy fibres is very obvious. The fibres of tendons are extremely tough, and therefore a much firmer hold of the bone is obtained through their intervention. Rupture or detachment of a muscle from the bone is therefore much less likely to occur where we find a tendon-insertion than if purely fleshy attachment to the bone were represented.

"Origin" and "Insertion."—In describing any muscle two special points are noted by the anatomist. As will be presently shown, one extremity of the muscle remains fixed; the other extremity is its moving end. The fixed point of a muscle is termed its *origin*, the other extremity is known as the *insertion* of the muscle. The meaning of these terms will be better understood when a description of muscular action is given.

Varieties of Muscle.—Turning now to the consideration of the muscles of the body at large, we find two varieties of muscular tissue included in the belongings of our frame. Thus we find muscles which, representing ordinary flesh, are of red colour. In our bodies

other muscles, however, exist, and these are of lighter hue. It may be here mentioned that in some birds, as in the familiar case of the common fowl, the muscular tissue is of a white colour throughout. With regard to our own muscular system, a very striking difference is found to exist in the nature and functions of these two classes of muscles. All the ordinary muscles of the body are of red colour. Furthermore, as we can move them when we like, and as they are therefore under the command of the will, they are named *voluntary muscles.* If we wish to move an arm or leg, for example, we know we possess the power to do so, and the same remark holds good of such muscles as are represented by those of the face, cheeks, lip, tongue, and other regions of the body.

Fig. 35.—Small Bundles of Muscle-fibres showing the Flesh above passing into Tendon below.

The second class of muscles differs from the first in respect of the fact that they are not under the direct control of the will. The white muscles may act not merely outside any command exerted over them by our brain, but of their action we may be quite unconscious; hence this latter variety of muscle-tissue is termed *involuntary muscle,* for the plain reason that its functions are exercised outside our will.

Illustrations of involuntary muscles are found in those of the walls of the stomach and of the intestine, destined to propel the food through the digestive tube. Of their action in health we are practically unconscious. The delicate muscular layer found in the walls of blood-vessels is also of involuntary character. The fact that blushing is an action over which we have no control demonstrates the involuntary action of the muscular layer of the fine blood-vessels, seeing that the action in question is produced by the relaxation of the fibres causing an increased flow of blood to the surface of the skin. Another excellent illustration of involuntary action is found in the case of the movements of the pupil of the eye. This last is the opening in the middle of the eyeball through which light-waves pass into the eye's interior. If we look at a bright light we see the pupil grow smaller. It contracts under the stimulus of the light. If, however, we shade the eye, we at once notice the pupil to expand. These changes are even better seen in an animal like the cat than in a human being. The dilatation and contraction of the pupil are

carried out by means of involuntary muscular fibres. A very large amount of what we may term bodily trouble is saved us by the action of this latter class of muscles. Their action being carried out independently of our will, saves us from the need of exercising constant attention with regard to their duties.

The Build of a Muscle.—With reference to the more intimate structure of muscle, we note that this tissue is composed of a large number of bundles of fibres called *fasciculi* (Figs. 35 and 36). These bundles can be teased out into their individual fibres, when each is found to be covered by a delicate sheath known as the *sarcolemma*. In many cases a muscular fibre itself can be split up into smaller fibres called *fibrillæ*. Finally, when the structure of these ultimate fibrils is examined, it is found that they can be separated crosswise into discs or rounded portions. If a fibril be examined under a microscope (Fig. 37), in the case of voluntary muscle, it is seen to present an appearance of cross-striping. Such muscles are termed *striated* or *striped* muscles. We note a series of direct lines alternating with lighter ones. This appearance is explained by the structure of the fibril itself. It is really composed of two distinct elements or discs; one of these (*b*) allows the light to pass through, and constitutes the clear stripe; the other obstructs the light, being of thicker and more opaque character, and forms the dark stripe of the fibril. The name *sarcous elements* has been given to the thicker blocks or discs (Fig. 37, *a*) of the fibril of the muscle. It is highly probable that the sarcous elements just mentioned constitute the true seat of muscular contraction. As a muscular fibre really represents a development of protoplasm (or living matter), and as each muscular fibre contains protoplasmic elements, we may assume that the action of the fibres of the muscle, and therefore of the muscle itself, practically represents a variety of movement of this substance.

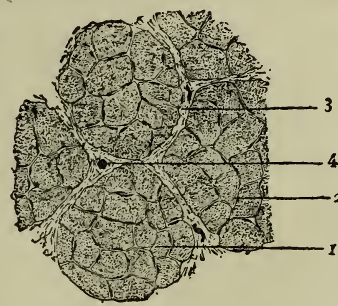


FIG. 36.—Section across a Piece of Muscle, showing a Smaller Bundle of Fibres at 1, the Border Line between one Bundle and others at 2, Space with Fascia between Bundles at 3, and a Blood-vessel at 4.

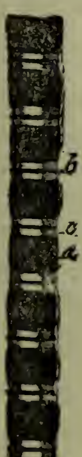


FIG. 37.—A Muscle-fibre (voluntary) Magnified to show the Thick and Thin Discs of the Fibre.

Involuntary Muscle.—Turning to the structure of the white or involuntary muscle-fibres, we find these latter under a microscope to exhibit an absence of the cross-striping described as

proper to the voluntary fibres. Seeing that the fibres of involuntary muscles are composed of spindle-shaped cells (Fig. 38, 1, 2) united to form the fibril, we can readily understand that in this latter case no cross-striping is possible. Hence the involuntary muscles, in contradistinction to their opposite neighbours, are termed *unstriped* or *nonstriated* muscles.

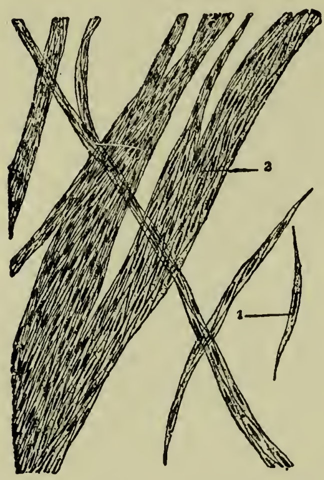


Fig. 38.—Fibres of Involuntary Muscle. A Single Cell is shown at 1, and Cells combined to form Fibres at 2.

The Heart Muscle.—One important observation connected with the differences between voluntary and involuntary muscles refers to the nature of the muscular substance of the heart itself. The heart is of course an involuntary muscle, seeing that it performs its duties independently of our will. At the same time the heart is liable to be influenced by the nervous system in various ways. We should expect the fibres of the heart to present us with the structure of involuntary muscle, and to be included in the category of unstriped muscular tissue. But the heart fibres are striped, and this fact would appear to suggest that they constitute a kind of half-way house between muscles of the voluntary and those of the involuntary kind. The fibres of the heart exhibit certain other peculiarities. They are not invested or covered by a sheath, whilst they branch and unite with one another. Under the microscope the muscular fibres of the heart are seen to be composed of oblong cells, each containing a distinct particle in the centre, called the *nucleus*. In all probability these peculiarities as demonstrated in the structure of the heart-muscle are connected with the special work of the heart as the central organ of the circulation.

THE ACTION OF MUSCLES

We are now in a position to understand the manner in which muscles act in the production of movements. It will be understood that the active part of a muscle is the fleshy part or "belly," previously described. The tendons or sinews do not act, but are acted upon. It has already been shown that each muscle is attached between two distinct points, and that one of these points is practically fixed, this being known as the *origin*

of the muscle. If now we conceive that with a fixed point above and a moving point below (known as the *insertion*), the belly or body of the muscle grows shorter or contracts, we readily note that the lower point of attachment will be brought nearer to the upper and fixed end. Taking the familiar case of the biceps muscle (Fig. 39) which forms the fleshy prominence of the upper arm, we find the origin or fixed point of this muscle to be represented at the shoulder (a). Its insertion or moving point is found in its attachment to the radius bone of the forearm (c). Now the duty of this muscle is to bend the forearm on the upper arm. It is clear that when the arm is extended, as when it hangs down by the side of the body, the muscular fibres are relaxed. Suppose, now, that the fibres of the biceps begin to contract, or in other words, to shorten themselves, we see at once that, fixed at the upper end, the lower or radius end of the muscle (and the forearm) will be brought nearer to the shoulder, and the duty of the biceps in bending the forearm on the upper arm will then have been accomplished.

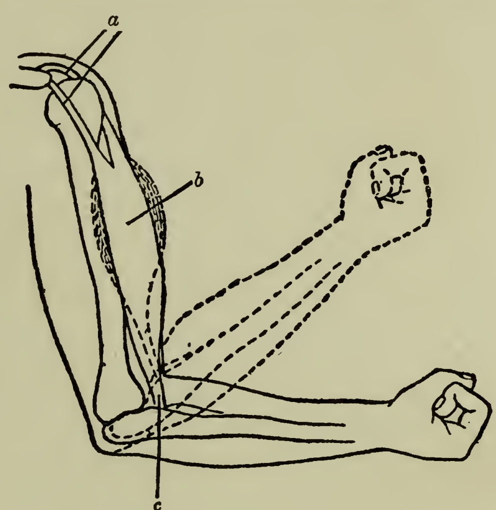


FIG. 39.—Diagram of Action of Biceps Muscle. *a*, Double Tendon of Muscle (*origin*); *b*, Body or Belly of Muscle; and *c*, Insertion in Radius. The shaded outline represents the muscle when contracted.

How Muscles Act.—All muscles act in this way because their fibres possess the property of *contractility;* that is, they are endowed with the power of shortening themselves. They perform this action at the command of the nervous system. It must be clearly understood that contractility is the property of muscular fibre. It is not a something which is dependent on the nervous system, or on the stimulation derived from this system. All that the nervous system does is to call this property into play. Each muscle exercises one function. When the forearm has been bent or flexed on the upper arm by the action of the biceps, it may be asked how can it again be straightened? The answer to this question is found in the action of another and different muscle called the *triceps.* This latter muscle lies along the length of the elbow. When the biceps is contracted and bends the forearm the fibres of the triceps are in a state of relaxation; but if the triceps in its turn contracts, it is bound to

extend the arm in opposition to the action of its neighbour, the biceps.

Flexors and Extensors.—In a similar fashion we note that the muscles lying on the front of the forearm are those which bend the fingers. They are therefore termed *flexor* muscles. In order that the fingers may be extended the muscles of the back of the forearm, whose sinews we observe in the back of the hand, come into play and straighten the fingers. These last are *extensor* muscles. The action of one group of muscles on the body is thus found to be frequently opposed to that of another group. Yet another example of muscular action is seen in that of the great muscle of the calf of the leg (Fig. 40). The function of this muscle is that of raising the heel, an action it performs habitually in the act of walking. If we suppose the foot to be placed firmly sole downwards and the heel then to be raised, as when a person stands on tiptoe, this action is performed through the contraction of the calf muscles, the big tendon of which, known as the *tendo Achillis,* is inserted into the heel bone. The upper end of the muscle (or origin) remains a fixture, and therefore any contraction of the fibres is bound to raise the heel from the ground.

Fig. 40.—Diagram of Action of Calf Muscles. The Shaded Part shows the Muscles Shortened and Thickened on Contraction.

The Action of the Biceps.—A simple mode of demonstrating the fact that shortening of the muscular fibres is the source of all our movements may be found in a simple observation. If we keep the right arm extended and place the left hand over the biceps muscle and then begin to bend the forearm on the upper arm, we shall feel the biceps grow *thicker and shorter* (see Fig. 39, shaded portion) as the result of its contraction. In the same way, if we raise the heel from the ground whilst grasping the calf muscles, a similar demonstration of muscular action can be obtained.

It is not necessary in a work of this kind to enter into a description of the various muscles of the body, but certain other facts connected with muscular action may be duly noted. All our powers of movement are derived from the food we take. If the body be compared to a steam-engine, our food represents the fuel from the combustion of which our *energy* or the *power of doing work* is obtained. It is very interesting to note that the human engine, in

respect of the amount of fuel it consumes, is a highly economical machine, that is, having reference to the amount of work it performs. The best engines cannot compare with our own bodies in respect of this economic usage of the fuel supplied to them. The great source of muscular work in the body is found in the shape of our starchy foods, and also the fats we consume. These starchy foods are ultimately converted by digestion into a substance called *glycogen,* otherwise known as *animal starch.* This fuel, converted into sugar, is supplied to the muscles by the blood. It is ultimately split into carbonic acid gas and water given off as waste matter, whilst a certain amount of lactic acid is also set free. When this latter acid accumulates in the blood to an undue extent, rheumatism is thereby caused.

Fatigue of Muscle.—As in the case of all living actions where muscle has been used and exercised for a considerable period, symptoms of fatigue become apparent. This result is due to the fact that the muscle demands a fresh food supply, but it is also in part due to the accumulation of the waste matters, which are the result of the work of the muscle. An interesting feature with regard to muscular fatigue is that which teaches us that by means of *massage,* a process consisting in the kneading of the muscles, such fatigue may be largely abolished. It would appear that the effect of massage is to remove quickly the lactic acid and other waste products we have seen to represent the results of muscular work.

Another observation is interesting as showing how such removal of waste products constitutes a highly notable feature in the renewal of our muscular activity. It is found, for example, that if the muscle of a frog removed from the body or otherwise deprived of its supply of blood is working feebly, it can be awakened into activity by sending through its blood-vessels a solution of salt. Here we note that whilst the muscle is not receiving anything in the way of nourishment, the salt solution tends to remove the waste products of muscular action. Muscles are abundantly supplied with blood-vessels and also with nerves, the latter forming the means of communication between muscles and the nervous system.

Muscular Action.—With reference to the rapidity of action of the two kinds of muscle, voluntary and involuntary, it may be noted that the latter class of muscle acts less rapidly, and its contractions take place more slowly, than in the case of the voluntary muscles. This result is probably due to the fact that the former, being more directly connected with the nervous system, and being more frequently called into play in the ordinary actions of life, have developed a quicker response to any stimulus proceeding to them from the nervous system.

Certain irregularities in the action of muscles may be here alluded to. If we suppose that after a stimulus (or order to act) has reached the muscle, another stimulus succeeds the first so rapidly that the fibres of the muscle have no time to relax, we find the fibres tend to remain in a permanently contracted and rigid condition. The muscle might be described in this case as suffering from a kind of "cramp." This is actually what occurs in that serious disease known as *tetanus*, or "lock-jaw." Such a result is familiarly seen as the result of a strong electric shock. The person in such a case cannot release himself from contact with the battery. The effect of the shock has been to produce a series of rapid contractions of his muscles, preventing them from relaxing, and retaining them in the rigid condition.

Death and Muscle.—After death certain important changes are noticed to occur in connection with our muscles. It may be assumed that in a living muscle one of the most important constituents of the fibres is a semi-fluid or gelatinous substance known as the *plasma* of the muscle. This substance after death coagulates or clots, and becomes more or less of a solid nature. Owing to this cause we find that after death the muscles tend to become rigid and to produce the well-known stiffening of the body that follows decease. This stiffening is technically called *rigor mortis.* Its advent in the case of the body differs materially under different circumstances. Thus if a person has died suddenly whilst in the possession of good health, the muscle stiffening will not appear for a considerable period, and in this case it will last proportionately long. On the other hand, when a person has died in an exhausted state, muscular stiffening may be expected to occur very soon after life has departed. In this latter case it also disappears quickly.

Other results of muscular action may be referred to under the head of the development of heat. The direct source of our bodily heat is of course the food we consume, but the muscular system might be compared to the grate in which the fuel is burned, for a large amount of the heat of the body is due to the work of the muscles. It is also known that in connection with muscular contraction electrical force is developed; the exact relations of this latter form of energy to muscular work is still a matter of uncertainty, but that it is intimately connected with the healthy action of muscular tissue, is a point regarding which most physiologists are agreed.

SECTION III

GENERAL DISEASES

Whilst for the most part the ailments from which we suffer may be described as *specific* in character—that is to say, each being regarded as being due to a certain definite cause—there falls to be considered in addition certain general states of body which in themselves may be said to constitute the result of diseased action rather than ailments of special nature. Hence it is interesting, as well as important, to consider first of all these *General Diseases*, or, as they may more properly be termed, *Diseased States.* As illustrations of the states in question may be mentioned *inflammation*, *dropsy* of various kinds, and alterations of the structure of organs, described under the general name of *enlargement* or *hypertrophy*, and the opposite condition, *wasting* or *atrophy.*

It will readily be noted that most of these represent results of disease rather than direct illnesses, but they are of such frequent occurrence, and present each so many common or general features, that it is necessary to devote a special section to their consideration.

Another section of ailments which may also be appropriately considered under the head of " General Diseases " is that which includes the description of such serious troubles as *tuberculosis*, *cancer*, *lupus*, *scurvy*, and the like. Associated with these troubles we may find reason to include in our list *rheumatism* and *gout*, whilst in connection with the subject of *scurvy*, a disease due largely to improper feeding, an ailment like *rickets* may also fall to be included.

If we choose to adopt what is another and important addition to the list of so-called general diseases, we may also find it appropriate to add to our list such an ailment as *obesity* or *excessive corpulence.*

INFLAMMATION

We may commence our consideration of these important topics with *inflammation* itself. This condition offers an excellent illustration of the fact already expressed, that certain conditions of body

are associated with and occur in the course of many different disorders. Inflammation may thus be represented by the results of a simple scratch. Still more typically may it be seen in the case of a poisoned wound. We find this condition to form a prominent feature of ailments represented by many lung troubles, and if any near approach to the ranking of inflammation as a separate disease be found, it might be discovered in that condition of the lungs known under the name of *pneumonia*, or inflammation of the organs in question.

The more convenient procedure, however, for our present purpose will be that of regarding inflammation as a process frequently accompanying the course of other diseases. Its general consideration may therefore lead afterwards to the better understanding of the more prominent ailments, which will in due course of time be treated of in this work.

Its Signs.—In the classic times inflammation was fully recognised as a diseased state. The ancients summed up the main features of this condition under the head of *heat, swelling, redness, and pain.* It cannot be denied that in the vast majority of instances this description fully applies, for in the case of ordinary inflammations all four symptoms are typically represented. In the case of an inflammation of the finger, for example, due to the reception by the body of some irritant or poison, we find the first symptom to be that of pain; this is accompanied at an early stage by redness, while the temperature of the part is unduly increased, and finally swelling sooner or later completes the quartette of signs. Needless to say the mere enumeration of the symptoms of inflammation throws no light upon the particular causes of this condition. We may be well within the mark if we assume that these causes arise from very varied sources. A modern view of inflammation takes the form of the belief that it represents not so much a diseased process in itself, as the attempt of the body to rid itself of diseased products or sources of irritation. If this view be accepted we see that in inflammation we ought to discern the reaction of our frame against the causes and conditions which tend to produce disease.

Inflammation under the Microscope.—Scientific research and careful observation with the microscope upon animal tissues which, as in the case of the web of a frog's foot, can be easily inspected, have thrown considerable light upon the nature of this disease. There is little doubt that inflammation in its earlier stages is manifested or marked by expansion or dilatation of the minute blood-vessels of the affected part. To what this change is due is an open question, but we may not be wandering far from the truth if we

assume that directly or indirectly the nervous system is responsible for causing the expansion and an increased flow of blood. In this way we find the blood supply of the inflamed part much increased. This fact also explains to us the rise in temperature and the presence of an increased degree of heat in the affected part. Later on, however, we find the rapidity of the circulation in an inflamed part decreases. The rapid flow is exchanged for one proceeding at a much slower rate, and eventually there would appear to be an actual blockage of the circulation.

The whole process so far might be compared to the conduct of the traffic in the streets of a great city. Under ordinary circumstances the various vehicles proceed regularly and without interruption along

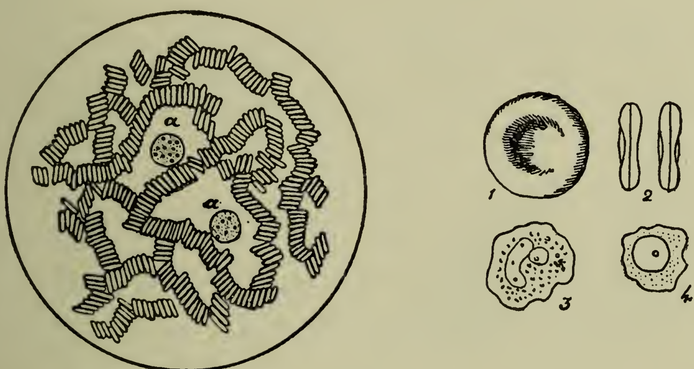


Fig. 41.—A Thin Film of Blood seen under the Microscope. The Red Corpuscles lie in *rouleaux*. *a*, *a*, are two White Corpuscles; 1, a Red Corpuscle seen from above, and 2, from the side; 3, a White Corpuscle showing its Nucleus or Centre; 4, a White Corpuscle beginning to undergo change in Form.

the streets. Where, however, any block in the traffic occurs, the progress of the vehicles is at first slowed and finally arrested. Comparing the vehicles in this case to the *corpuscles* or solid particles of the blood, we note how in inflammation the ordinary rapidity of their course finally ends in their arrest.

A Living Battle.—A remarkable series of investigations was made by Metschnikoff on the part played by the elements of the blood in inflammation. It must be explained that floating in the blood are two kinds of solid bodies or *corpuscles* as they are termed. These are respectively the *red* and the *white corpuscles* (Fig. 41). The former exist by millions in the blood and give to it its red colour. The white (*a*, *a*) are not so numerous as the red, and differ from the latter in respect of the fact that each is an independent living particle. Each

white corpuscle (3, 4) may be compared in its way to a living animalculæ, composed of a microscopic speck or protoplasm or living matter, capable of feeding itself and of moving about independently of the body of which it forms an essential constituent (Fig. 42, *A*). These white corpuscles, otherwise known as *leucocytes* and *phagocytes*, are thus seen to be capable in health of passing through the thin walls of the finest blood-vessels and of wandering at their own sweet will amongst the tissues of the body.

It has further been noted that they are capable in man and other animals of attacking and disposing of foreign particles (chiefly represented by *disease germs*) which may gain admission to the body. They have actually been seen engaged in this work (Fig. 42, *B*); hence by a certain school of physicians our escape from many diseases is attributed to this feeding action of the *leucocytes* of our blood. The preservation of health against disease might in this way be compared to a veritable battle continually taking place between the leucocytes on the one hand as the defending force, and diseased germs on the other as the attacking army. If the leucocytes are capable of destroying and defeating the invaders we escape disease. On the other hand, if the disease germs are too powerful for our white corpuscles, and if the microbes breed and multiply to such an extent as to affect the body, our protecting army suffers defeat and we fall victims to disease attack.

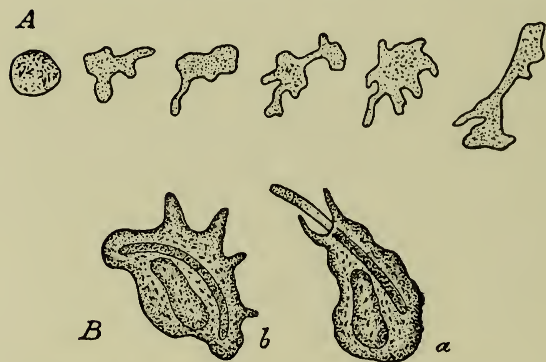


Fig. 42.—*A*, A White Corpuscle moving about through Changes in its Shape. *B*, Two White Corpuscles; one at *a* engaged in attacking a Disease Germ; at *b*, the same Corpuscle is seen having completely invested the Germ.

Our Bodily Defences.—In considering inflammation we have to take into account this wonderful action on the part of these leucocytes, which might be compared to a bodily sanitary police force. What is seen in inflammation when the blood flow has been slowed down and comes to the stage of blockage, is that the leucocytes instead of passing along the blood-vessels in their ordinary fashion attach themselves to the walls of the blood-vessels and form a layer thereon. This action seems to be parallel to another and one of much importance in so far as the results of inflammation are concerned. The leucocytes begin now to push their way through the walls of the

blood-vessels and thus gain admittance to the tissues around. To what this tendency to emigrate from the blood-vessels to the tissues is due is an open question. Metschnikoff himself attributes the emigration of the white corpuscles in inflammation to some instinct on their part, or attraction for them set up by the presence of the disease germs which are the cause of the inflammation. Along with the escape of the white corpuscles of the blood there also takes place an emigration of the red blood corpuscles, and the fluid part of the blood itself, termed the *serum* or *plasma*, also escapes at the same time. We have accounted for the *increase of temperature* which characterises inflammation. The *swelling* can now be similarly explained. It is due to the escape from the blood-vessels of the elements of the blood. The symptom of *pain* may also be accounted for by similar considerations, being chiefly due to pressure in the nerves. If we find in our tissues a certain amount of material which should be properly circulated throughout the blood-vessels of the body to be located in one part, the pressure to which the presence of such material gives rise may fully account for the pain.

The Result of the Battle. — Regarding the body in inflammation as representing a battlefield whereon is exemplified a very important struggle, we can follow out, with a fair amount of clearness, the subsequent stages in inflammation. In the first place, if we suppose that the leucocytes have been successful in ridding the body of the causes of the irritation, the inflammation will quickly subside, and the natural state of matters be once again resumed. In the case of a simple scratch of the finger, for instance, where there is necessarily a small amount of destruction of bodily tissue, such a result occurs. In a few hours at most healing takes place. Suppose, on the other hand, that the scratch represents a poisoned wound. If some foreign matter has gained access through the scratch to the body, the course of the inflammation in the latter case will run a more decided course. The symptoms of inflammation will duly appear. The finger will begin to exhibit pain, heat, redness, and swelling, and so, after a certain period, we shall find a formation of *matter*, or, as the surgeon calls it, *pus*. In order to relieve the inflammation, it may be necessary that the finger should be lanced when the pus is disposed of, otherwise, in a simple case, the matter itself may be absorbed and disappear. Now, if "matter" is examined by means of a microscope, it is found to be composed largely of dead leucocytes. In other words, the soldiers of our bodily army have been defeated, and their dead bodies constitute the "matter" we find associated as the result of one phase or termination of the process of inflammation.

As has well been expressed by a writer, just as the dead bodies of

soldiers on a battlefield may constitute, until they are buried, a source of danger to the surrounding country, so in the battlefield of the body, and in the contest we term inflammation, our dead leucocytes in the shape of " matter " may form a source of additional disease and danger to our bodily territory. If this matter be absorbed and carried by the blood to other parts of the body, it may there give origin to serious consequences, and what may be termed a " secondary infection " of the body (seen in many diseases) may thus take place.

The End of Inflammation.—It may be assumed that as the result of inflammation in all its varieties certain products are thus produced. "Matter" is one of them. Where the inflammation is of slight character and tends rapidly to disappear matter is not formed, and the leucocytes probably aid in the work of producing new cells and tissues whereby, say, a wound is rapidly healed. In other cases we may find that the products of inflammation are more or less of a fluid or semi-fluid matter. In many lung troubles, for example, the expectoration which is brought up, consisting of matter poured out from the surface of the lung, represents this latter form of inflammatory product.

A greater solidity may be found in some cases as the result of inflammation. If we take the case, say, of such a disease as diphtheria, where a certain membrane forms in the throat and upper part of the windpipe, we note in such a case a more serious change taking place in the products of inflammation. It would almost appear in such a case as if the disease process tended to produce another and special kind of structure from the diseased elements of the body. Where inflammation assumes a chronic or lasting character, we may suppose that the products have acquired a more or less distinct amount of stability. Here there is little tendency for them to be absorbed, and, as a consequence, instead of disappearing, they remain to form permanent parts of the organ which has been affected. An example of this effect is seen in the case of " drunkard's liver." As a consequence of the inflammation of this organ set up by alcoholic excess, there is a diminution and lessening of the bulk of the organ with an increase in the proportion of certain structures, altering the liver's appearance and producing the characteristic hobnailed appearance of the organ. In the same way, after *pleurisy*, or inflammation of the *pleura* or lining of the membrane of the chest, we may find the membrane covering the lung adhering to that lining the wall of the chest. Such adhesions represent products of inflammation which, instead of disappearing, may be regarded as having been organised to form a new variety of bodily tissue, seriously interfering with the work of the lung by preventing its free movement.

The Terms Applied.—Having regard to the various ways in which inflammation of a part may end, and excluding the exact manner in which the varying results may be brought about, we find physicians accustomed to describe such results in various terms. If inflammation ends in what is called *resolution*, this implies that the diseased products are quickly absorbed, and that they leave no trace behind. More serious is that mode of termination of the process known as *suppuration*. This ending has already been described under the head of the formation of *matter* or *pus*. It is well illustrated by the case of an *abscess* or collection of matter, which may often be of considerable size, and which has to be evacuated by the surgeon's knife. The third mode in which inflammation may terminate is a state known as that of *ulceration*. Here the process results in the destruction of tissue, leaving a raw surface, which gives off a certain amount of discharge. This process is familiarly exemplified in *ulcers* or *sores* of all kinds. Finally, if this latter process proceeds to an extreme degree, we find inflammation ending in what is called *gangrene*. This term practically implies the death of the part, and is popularly known under the name of *mortification*. It need hardly be said that this last mode of termination of the inflammatory process is the most serious of all.

Metastasis.—A feature of inflammation which deserves notice is the peculiar tendency exhibited in certain cases in which this process is involved for the inflammation to transfer itself from one organ of the body to another without apparent cause. A child affected with mumps, for example, to quote a common illustration, will sometimes be troubled with swelling of the testicles. In the case of the female sex the effects of mumps may be transferred to the breast. The essential feature of mumps is an inflammation of the chief salivary gland of the mouth, as well as of the other glands, and it is an extremely curious circumstance that apparently the diseased principle should exhibit a tendency to transfer itself in the way described from one organ to the other. This process of transference has been termed *metastasis*.

Treatment of Inflammation.—Proceeding now to discuss the *treatment of inflammation*, a few general observations on this subject may prove of service to the reader. It will be understood that special inflammations, or those connected with specific diseases, require to be treated on principles which include the accurate consideration of the ailments in question. If, for example, we may suppose that a specific inflammation of certain glands of the bowel constitutes the special feature of typhoid fever, the proper treatment in such a case would necessarily be that directed to the control of the fever at large.

Where, however, a more special and detailed case of inflammation of a part has to be dealt with there are certain general lines on which its treatment may be conducted.

It is curious to note the difference between the old and the modern treatment of inflammation which is apparent in the practice of to-day. It was the custom of our forefathers to undergo periodical blood-letting. Every spring blood was abstracted from the vein of the arm, under the notion, apparently, that with the reviving season of the year came a tendency to fulness of the blood supply. It is hardly needful to remark that this practice has happily fallen into oblivion. In medical practice of old, a prevailing fondness for blood-letting as a cure for inflammation was typically represented. Almost every ailment, whether inflammatory or not, was treated by the opening of a vein, and by the withdrawal of a certain amount of blood. The idea underlying this practice was evidently that of supposing by diminishing the *quantity* of blood the causes of the trouble would be removed. We know to-day that it is not a question of the *quantity* of blood in the body, but rather of the *quality* of the blood as altered by the diseased products which have gained admittance to it. No amount of removal of spoiled wine from a barrel can possibly alter the character of the vintage, and it is so with the body. Blood-letting is therefore not now practised as a remedy for inflammation in the sense in which it was exhibited in the practice of our forefathers.

Blood-letting.—There are certain cases undoubtedly in which the removal of blood may have the effect of lowering the tension or pressure, and this practice is followed by many physicians with advantage to-day in cases of apoplexy. It is also practised in certain cases of rapid inflammation of the lungs and in other lung troubles. In a modified form, also, blood-letting may be employed for relief of the inflammatory process. Thus the application of *leeches* to the inflamed part may be followed by favourable results.

Leeching.—The leech possesses three teeth arranged in a circle. These teeth bite through the skin and make a triangular or "Y"-shaped wound, through which the blood can be readily drawn. A leech may be regarded as capable of removing about a dessert-spoonful of blood; the subsequent bleeding from leech-bites tending to a larger amount in the way of blood-letting.

To Apply Leeches.—In order to apply leeches properly, the skin should have been previously cleansed with soap and afterwards with tepid water. Occasionally a refractory leech may be made to attach itself to the part by first pricking the skin with a needle and allowing the worm, so to speak, to taste blood. The leech should never be pulled off the skin after it has become attached. It cannot

draw an excessive quantity of blood, and if forcible attempts be made to remove it, the probable result will be that its teeth may be left in the wound. Allow it therefore to drop off naturally. If laid thereafter on a plate containing a little salt and water, it will generally disgorge its blood. It may then be placed in a fresh basin of water, and will be ready later on for another application. A glass tube is sometimes used in order the more readily to apply the animal to the skin. This is a tube into which the leech is placed, and is thereby induced to pass through the tube to the other extremity which has a smaller opening. It is this extremity which is placed against the part on which it is desired that it may fix itself.

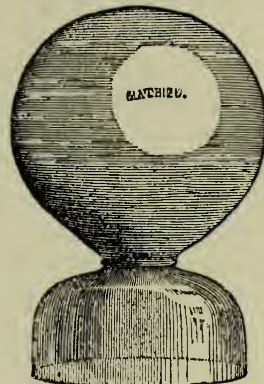


FIG. 43.—Cupping-Glass with Indiarubber Bag for attachment by Air Exhaustion.

Cupping.—Blood may be drawn for the relief of inflammation by other means than leeching. *Cupping* is a familiar illustration of one of these methods. A cupping-glass (Figs. 43–45) may be described as a small tumbler. The skin is incised with a clean knife or lancet or by means of an instrument (Fig. 46) which possesses small blades made to act by the release of a spring. The cup is held for a moment over a flame so that the air within it is expanded; on being applied, the skin is then drawn into the cup through the cooling of the air, and blood is thus removed. What is known as the process of *dry cupping* is similarly carried out without scarifying the skin at all. This latter process is extremely useful in many cases of disease of the kidneys, of which inflammation is a prominent feature. It is also found useful in certain cases of inflammation of the lungs. Scarification is also employed as a means of blood-letting. This mode consists in making a number of superficial cuts or scratches in the skin by way of withdrawing blood.

FIG. 44.—Cupping - Glass with Tap for releasing the Air.

Heat and Cold.—*Heat* and *cold* represent two modes of treating inflammation familiar to all in the common practice of life. A black eye which has applied to it a piece of beef-steak illustrates a case in which the influence of cold is expected to modify the course of the ailment or accident.

Cold compresses formed of plies of lint moistened with cold

water, applied to inflamed parts and covered with oiled silk to prevent rapid evaporation of the fluid, also illustrate the use of cold in reducing inflammation. Such compresses require, of course, to be frequently renewed. Other methods of the application of cold are represented by the use of *ice*. Placed, say, in a sponge-bag, a mass of ice, crushed into small pieces, may be readily applied to any part of the body. This mode of treatment is found especially useful by way of application to the head.

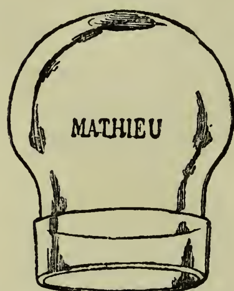


FIG. 45.—Ordinary Cupping-Glass.

What is known as *irrigation* consists in the application of cold water, which is allowed to escape from a vessel by means of a piece of wick or similar substance. The water trickles down, drop by drop, on the affected part and thus maintains a constant cooling action.

Leiter's Coils.—Surgical appliances known as *Leiter's Coils* offer a very ingenious and at the same time convenient mode for the application of cold to any part. This appliance consists of a metal tube in coils. Being flexible, it can be moulded to suit any special region of the body. A constant stream of water is made to pass into the coil by one extremity and out by the other.

In addition to these methods of applying cold water for the treatment of inflammation, various lotions are capable of being used. Where ice is not at hand, a useful lotion for the application of cold may be made by dissolving 5 oz. of sal ammoniac and 5 oz. of nitre in a pint of water. This can be applied by means of a bladder to any part. In the same way spirits of wine and water or eau-de-cologne and water form cooling lotions, which act chiefly because the spirit produces rapid evaporation from the surface of the skin. A lotion composed of 1 oz. of rectified spirits of wine added to 15 oz. of water is an excellent cold application, and if to this be added 4 drachms of nitrate of potash, or 4 drachms of chloride of ammonium, the cooling effect will be much increased. Vinegar and water is another application within the reach of all.

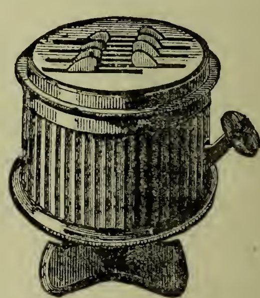


FIG. 46.—Scarifier, showing Blades of Lancets above.

Hazeline may be mentioned as a substance which has attained a very considerable reputation for use as a cooling lotion. It is a preparation of the bark of the witch hazel-tree of America. It is a valuable astringent, and can be used also for the checking of bleeding

of both external and internal kind. Being non-poisonous, it can be administered in a teaspoonful dose alone, or diluted with water in case of bleeding from the stomach or lungs.

Cold in Inflammation.—The general tendency of *cold* as applied to the treatment of inflammation is that of checking the formation of "matter," and of producing a return to the natural state as regards the blood, by preventing the further migration of the white blood-corpuscles from the blood-vessels. We can readily understand that where this action can be arrested through the application of cold, the tissues then obtain an opportunity to reassert their vital powers, as it were, and to cause a return to the normal state. Occasionally, however, where the process of inflammation has already proceeded to a certain extent, it is found advisable to apply heat. By this latter method of treatment the work of the white blood-cells would appear to be favoured and encouraged; and if, as the result of hot applications to the inflamed part, "matter" may be formed, this result being hastened by the heat, will represent the leading idea of the treatment—that of forwarding the inflammation onwards towards its close by *suppuration*.

Heat Application.—The most familiar examples of the application of heat are thus represented by the application of *hot poultices* and by *fomentation*. With regard to the principle which might guide us in applying heat or cold for the treatment of an inflamed part, we might adopt the general view carried out in medical practice of assuming that where any part of the body thus attacked presents us with a fair amount of looseness of tissue, cold may be preferred to heat. Where, on the other hand, the parts affected are of a denser and tighter structure, so to speak, heat may be preferred. The already quoted case of a blow on the eye would suggest an application of this principle. The application of cold, seeing that the parts affected are composed of tissues of a more or less loose description, will be the more likely agent of the two to reduce the inevitable swelling which takes place. On the other hand, heat favouring the formation of matter through its encouraging the emigration of the leucocytes or white blood-cells will be more legitimately applied to the position in which we find tightly bound structures. The palm of the hand furnishes an example of a situation where the application of heat would be more likely, in a case of inflammation, to be followed by good results than the application of cold. The general influence of heat being to favour the form of matter, or *suppuration* as it has already been termed, such matter can be the more readily and quickly got rid of being evacuated by aid of the surgeon's knife.

The preparation of *fomentations*, and *the preparation and application of poultices*, will be fully described in the section devoted to *nursing*. Suffice it to say that the all-important point to be attended to where heat is to be applied in order to afford relief is that it should be continuously applied. A poultice allowed to become cold may in this sense constitute a veritable danger to the patient.

Rest in Inflammation.—Another extremely important principle involved in the treatment of inflammation, and also in a vast number of other ailments, is that included under the general name of *Rest*. The importance of keeping an inflamed part in a state in which all movement is prevented and absolute rest afforded to it cannot be overestimated. Yet it so happens that this particular mode of treatment is one which is often utterly neglected, or at least, in respect of its importance, imperfectly understood. When we come to think of it, the principle of "rest" is one which forms a natural feature in the maintenance of the healthy body. It may be doubted if any organ of the body works continuously. Where a continuous action appears to exist, rest may be demonstrated to be represented in respect either of intervals in the work, or of a slowing down at certain periods of the vital process. If we take the case of the heart as a typical example of this argument, it can be demonstrated that our heart rests as much as it works. If we assume that the beats of the heart (two in number) represent its work, the intervals between the beats will correspond to its resting periods. The heart might thus be compared to a workman who takes his short intervals of rest between short spells of work. In the case of the tear-glands of the eyes, we note that in sleep their action is largely modified, and the action of the tears by way of moistening the eyes is reduced to a minimum. The action of the man who, when waking, rubs his eyes, represents his efforts to stimulate the tear-glands to renewed activity. In the case of the liver, through which a supply of blood is perpetually passing, we may also assume that during the period of sleep the action of secreting bile is practically slowed down. All this rest represented in the natural work of the healthy body, represents a principle which is reflected very plainly in the treatment of disease.

Examples of Rest Treatment.—When an inflamed part is therefore treated by placing it in a position in which all movement practically ceases, we exemplify the principle known as that of *local rest*. Nature herself in a very interesting fashion demonstrates her usage of this mode of cure. A physician, in dealing with the question of rest, remarks that "it is of so much value in the treatment of inflammation that in some instances no means will advance the cure without it, and numerous injuries of the body,

externally or internally, would do well with perfect local rest and nothing else."

A telling example of the benefit of rest in disease in the case of the heart is found where there exists inflammation of the sac or bag in which the heart is contained, an ailment known as *pericarditis.* It may be here mentioned incidentally that wherever the termination "*itis*" is found in a medical term, it implies inflammation of the part. In this particular heart-affection the patient is made to rest in the recumbent position, and it is stated that through the assumption of such a posture the beats of the heart are lessened to the extent of over 17,000 in the twenty-four hours. The immense saving of work and of bodily wear and tear represented in this instance may be extended proportionately to other organs of the body when affected by inflammation or other diseases. The stomach when in an inflamed state is made to rest through the giving of liquid food only, or through the administration of nutriment by the bowel, in which latter case absolute rest and freedom from discharge of the ordinary duties of the stomach is fully secured.

Other Examples of Rest Treatment.—An inflamed joint may thus tend very largely towards cure through the maintenance of rest in an easy position alone. In such a position not merely are all active movements of the joint suspended, but there is also a diminution of pressure on the injured parts, secured by the easy position in which the joint is maintained. A broken bone is naturally supported by splints in a position in which, all movement being avoided, the union of the broken parts may readily take place. In the case of broken ribs, for example, rest is secured by strapping the chest with plaster in order to limit the movement of breathing. *An inflamed eye* is kept from the light, and is in this way protected from a source of irritation which, in the case of a healthy eye, would really represent an ordinary natural stimulus. In inflammation of the bowels it is of the highest importance to secure the assistance of the rest-principle. The movements of the bowels are checked or suspended by the administration of opium, so that the inflamed parts, prevented thus from movement, may the sooner regain their natural state.

Diet in Inflammation.—Other means of treating inflammation are included in the consideration of diet and medicines. This latter subject represents naturally an extremely wide field. The means to be adopted for the treatment of special inflammation will most appropriately be treated of under the headings of the various diseases to be afterwards considered. For the present it is only necessary to indicate the general principles on which treatment according to these two methods may be pursued. Dealing first with the question of *food*, the main feature to be observed in the treatment of inflam-

matory diseases is that represented in the practice of giving what is ordinarily termed a *low diet.* Under this head are included foods which are of a non-stimulating nature. The chief resource of the physician in this respect is *milk,* given either pure, or having added to it such fluids as aerated alkaline waters. Where there is much depression or collapse, foods represented by beef tea, invalid bovril, broths, and the like may be given. It will only be in exceptional cases that the physician will order alcohol, which is, of course, a stimulant exercising a very decided action upon the heart. The aim here is simply to give the body a certain amount of nutriment, such as will provide for the maintenance of its working power at low pressure, and when the inflammation has subsided the return to the ordinary diet should be made very gradually. It would be a mistake of the most regrettable kind at once to give a patient the full diet to which he has been accustomed in health. In returning to the normal diet, the physician as a rule will prescribe animal foods of a non-stimulating character, preferring to begin with fish and fowl to ordering the stronger meats in the shape of mutton or beef.

Drugs in Inflammation.—The *treatment of inflammation by means of drugs and medicines* is again a matter for consideration relatively to the case of each individual disease. The aim of the physician, in so far as the administration of medicines is concerned, runs on parallel lines to that represented in the use of non-stimulating foods. The drugs prescribed in inflammation are more or less of the character of those known as *sedatives.* Of all drugs used in connection with the treatment of general inflammatory conditions and of the fever which may accompany them, *aconite* is that most frequently used. The effect of aconite is chiefly seen in its lowering effect on the pulse. In this way it may, with rest, form a valuable agent in reducing inflammation. It is a remedy which requires to be carefully used. The ordinary mode of its employment is to administer it in an acute case of inflammation in a one-drop dose every quarter of an hour (in the case of an adult) for the first hour, repeating this drop dose once an hour (after the first hour) for six or eight hours, until the pulse and fever have been reduced. A better mode of administering this useful drug is that of adding fifteen minims of the tincture of aconite to two ounces of water. The dose of this mixture will be a teaspoonful in the case of acute inflammation, attended with feverishness. One teaspoonful may be taken every quarter of an hour for the first hour, thereafter the same dose may be given once an hour for the succeeding six hours. The use of the mixture may then be stopped.[1]

[1] It should be noted that aconite, a remedy of the greatest value, should be carefully used. The mixture ordered is colourless, but the dose ordered must not be exceeded.

Amongst other drugs used for the relief of inflammatory conditions we must not forget to mention *purgatives*. The clearing of the bowels in cases of fever and inflammation at large represents a very old practice indeed. A great deal may be said in its favour, and there can be little doubt that in general conditions, of which inflammation forms a prevailing feature, the administration of a *saline purgative* to start with may accomplish much good.

An analogous case to this use of purgatives is seen where a saline purge cures a headache, and it is part of the treatment of apoplexy (where a blood-vessel is blocked or ruptured in the brain) to secure a rapid motion of the bowels by the administration of one drop or two drops of *croton oil*. The effect of this drug acting upon the intestine would appear to reduce the blood pressure at large; hence we may bear in mind the value of purgation and of securing an adequate movement of the bowels in most inflammatory conditions.

Purgation.—The proper purge to be used in a case of this kind is undoubtedly that we have described as saline. Under this head are included all mixtures containing substances of the nature of sulphate of magnesia, sulphate of soda, and the like. The familiar Epsom salts is sulphate of magnesia. A useful preparation of this kind consists of Rochelle salts, half-an-ounce; syrup of ginger, one teaspoonful; lime-juice, one tablespoonful; and water, four tablespoonfuls. These amounts form a draught which represents one dose. A familiar hospital mixture, calculated to act as an efficient purgative, is composed of two ounces of sulphate of magnesia, one drachm of powdered rhubarb, one drachm of jalap, and peppermint water, six ounces. The dose capable of producing purgation in an adult is a sixth part of this mixture.

Chronic Inflammation.—A few words regarding inflammation which has passed into the *chronic* or lasting condition may conclude the consideration of this topic. Instances of chronic inflammation are to be found in the case of disease affecting almost every organ of the body, from the stomach to the eye, and from the lungs to the joints.

The treatment of such cases is naturally a much more difficult matter than where we have to deal with cases of acute inflammation, which runs its course more or less quickly, and terminates favourably with the return of the parts to their natural condition. A joint which has become chronically inflamed through gout or rheumatism presents us with a condition in which its structures have become permanently thickened and otherwise altered, the movements and the proper use of the joint being thus rendered more or less impossible. Here our efforts are directed to promoting the absorption and the removal of the new structures which disease has produced in the

joint, and it is precisely the slow nature of the cure in such cases which forms the difficulty of the physician and the hard case of the patient.

Treatment.—Various means are adapted for the betterment of such states. *Baths* of various kinds, *douches* of hot and cold water applied to such parts, and the drinking of certain mineral waters by way of affecting the parts through the blood, represent means for the relief of such cases of chronic inflammation. A very large amount of good may be frequently accomplished in such a case by the use of *massage*, where muscles and joints are kneaded and otherwise affected by movements externally applied.

A very ancient practice in medicine in the way of treating inflammations which tend to become chronic is that represented by *blistering*. This principle acts through inducing what is called counter-irritation, and its main effect appears to be that of modifying the blood supply of the affected parts, whilst in another sense it may also act by stimulating the local circulation or that immediately connected with the inflamed organs. An ordinary fly-blister applied to the part represents this principle of counter-irritation. Other substances used in this mode of treatment are mustard and blistering fluids. In a milder way, counter-irritation may be applied by painting the surface with such a substance as tincture of iodine. This application, frequently repeated, will cause the skin to which it has been applied to peel off. This latter mode of treatment is applied to inflamed glands especially.

DROPSY

As in the case of inflammation, we may regard *dropsy* to be a symptom of disease rather than an ailment in itself. It may therefore be treated here on the same principles as those represented in the description of inflammation. Popularly, dropsy is spoken of as a collection of *water* in any portion of the body. The typical appearance of dropsy is that of swelling, only the swelling is of a somewhat loose description, and when the finger is pressed into it, a pit or depression is formed, which soon disappears through the return of the fluid and the filling up of the indentation thus made.

What Dropsy means.—The fluid present in any part of the body in a case of dropsy is, however, not simple water. It really represents the fluid part of the blood, this fluid being known under the name of *serum* or *plasma*, and otherwise as *lymph*. In order to explain the occurrence of dropsy, we have to take into account the manner in

FEVER ERUPTIONS, &c.

SCARLATINA OR SCARLET FEVER.

"STRAWBERRY" TONGUE.

TYPHUS FEVER.

TYPHOID ULCERS IN THE MOUTH.

TUBERCULAR ULCER.

DIPHTHERIA.

which the tissues of the body are nourished. Blood distributed to all parts of the body by the heart, at last finds itself in the smallest blood-vessels of the frame. These exist everywhere in the body, and representing the branching out of the arteries, are called *capillaries.* They are extremely minute tubes, with very thin walls, through which the blood-fluid escapes, and thus comes to bathe the tissues it is intended to nourish. Practically it therefore follows that, throughout the whole of life, there is a constant escape of this lymph or blood-fluid from these minute blood-vessels. It is also obvious that whilst a large part of this fluid must be used for the nourishment of the body, a certain portion of it, representing the excess, as it were, beyond what is required for nutrition, will tend to remain in the tissues were means not provided for its removal. The excess lymph thus poured out to nourish the body is perfectly carried away in the healthy subject by means of a delicate set of vessels found everywhere in the body, and known as *lymphatics* or *absorbents.* These delicate vessels convey the lymph back to the blood, so that nature appears here in the position of an economical provider, in that the lymph which has been once distributed to the body, after being liberated, goes back to the blood-stream to assist in renewing and repairing the vital fluid.

If now we suppose that some condition or other exists whereby the work of these lymphatic vessels is obstructed, or prevented, it is obvious that the excess must accumulate in the tissues. In other words, they will tend to become "lymph-logged." When such an event occurs *dropsy* is produced.

Causes of Dropsy.—With regard to the exact causes which prevent the absorption of the excess of lymph, these may be of varied character, and lead us in the direction of the distinct diseases of which dropsy forms a prominent symptom. Thus any obstruction occurring in the veins may be followed by dropsy. In such a case the fluid will accumulate in the lower parts of the body. Physicians also know that when the composition of the blood departs from its natural state, and an alteration has taken place in the quality of the blood-fluid, dropsy is likely to occur. We see this latter result illustrated in *anæmia,* or *bloodlessness.* There dropsy will occur in the feet and ankles, no obstruction of the veins necessarily taking place. What happens in a case of this kind is that the heart's action is slowed down, and is insufficient to maintain the circulation so as to force the returning blood upwards and onwards to the heart.

The Varieties of Dropsy.—There are three chief conditions under which dropsy may appear. It is extremely common in certain *kidney diseases.* In that form of kidney trouble known as *Bright's*

disease, dropsy forms an early symptom. Speaking of kidney dropsy at large, we find that it tends to become of a general character. It will be noticed as a rule most specially in the particular part of the body which is lowest according to the position of the patient. Thus, after lying in bed, the dropsy will be most likely noted first in the face, and in swelling and puffing of the eyelids. After the patient has been moving about, the legs will be observed to swell, the puffiness existing chiefly in the neighbourhood of the ankles. In a more pronounced case it will be found that even the side of the face on which the patient has been lying in bed will be found swollen, whilst the other side is free from this symptom. In kidney-disease dropsy may thus be of a very general character, and may affect the cavities of the body itself.

The Heart and Dropsy.—Dropsy also occurs in cases of *heart-disease.* In this instance it will be found commencing at the ankles and top of the feet at the close of the day. In the morning, owing to the rest of the patient, the swelling may have disappeared. Dropsy dependent upon heart-disease, obstructing the due return of the blood in the veins, creeps upwards in the body. Another variety of dropsy is that connected with the *liver.* A very large vein, known as the *portal vein*, carries blood into the liver. If any condition, such as that of the pressure of a tumour, occurs to obstruct the flow of blood upwards in this vein, we find a dropsical condition induced known as *ascites.* Such a condition is found in cases of liver-disease depending on drunkenness, cancer, or other causes.

Treatment of Dropsy.—The treatment of dropsy naturally depends on the particular source of the ailment. If due to heart or kidney trouble, for example, the particular affection of each organ must be duly treated. Reference will be made to modes of treatment under the heading of the respective diseases in question. It may, however, be said that the relief of dropsy is usually undertaken first by tapping the body and removing the fluid. The second class of remedies includes those devoted to curing the disease to which the dropsy owes its origin. Rest is of high importance in the treatment of dropsy, and the general principle represented in this latter mode of treatment is to support the swollen parts and to raise them. Where drugs are administered for the special relief of dropsy, they will be mostly directed to increase the action of the skin and the kidneys. The administration of purgatives, by way of relieving the body of so much of the excess of fluid through the medium of the bowels, also forms a feature of the medical treatment of this disease.

SCURVY

Another general disease depending upon an altered state of the blood is that known as *scurvy*. This disease has long been known to medical science. It has enjoyed a very unenviable reputation as often occurring in widespread and epidemic fashion. Armies have been affected with it in the past, and Arctic and Antarctic exploring expeditions have suffered severely from this ailment. In olden days Captain Cook's expeditions suffered severely from scurvy. In the course of his first voyage he lost a large number of men from scurvy-attack, and his attention was naturally directed to the causation of the disease. His first voyage round the world lasted from 1772 to 1775, and as the result of the experience acquired at this period, Captain Cook formulated certain opinions regarding its causes, and also concerning the means to be adopted for its prevention. His opinions may be said to have laid the foundation for the views of modern science regarding the ailment.

Its Cause.—Briefly stated, scurvy is a disease dependent upon errors in diet. Stated in a general way, the main cause of scurvy appears to be the want in a diet of those food principles we chiefly obtain from fresh vegetable matters. Amongst the items obtained from vegetables we find that potash and certain organic acids included in the mineral constituents of vegetables appear to be of the highest importance in maintaining the natural composition of the blood. When these are wanting in a diet, scurvy breaks out. It has been noted to occur in prisons and workhouses where an adequate supply of milk has not been provided, the disease disappearing when a return to the proper dietary has been made.

To take an exact illustration, we find that *lime-juice* is a preventive of scurvy, and by law, in the case of all sea-going ships, after an interval of ten days or so at sea, each person requires to be supplied with an ounce of this juice per day. Now in lime-juice we find certain salts called *citric acid* and *citrate of potash* In the body these are oxidised or resolved, so to speak, into carbonic acid gas given off from the lungs, and carbonate of potash. The administration of lime-juice thus supplies potash to the blood in cases where the use of salt foods and other like articles of diet do not provide a sufficiency of such materials. Scurvy is prevented from appearing in ordinary life by the use of a healthy diet. Thus potatoes contain potash and other minerals which prevent the appearance of this disease. A notable instance of this fact was afforded in the case of the Irish famines, where, though the people were starved and meagre, and existed under

conditions of great privation, no scurvy was developed because they had a sufficiency of potash. Fresh meat itself, containing so much of the blood of the animal, and presenting us therefore with salts of potash, acts as an *anti-scorbutic*, that is, a *scurvy-preventer*. It would seem that scurvy is more liable to occur in persons who are poorly fed. In recent Arctic expeditions the plentiful use of animal flesh prevented the development of the disease. We note, therefore, that the use of salt food alone will not directly produce the disease, but no doubt such a diet acts as an indirect cause through the absence, or reduced quantity, of such foods as potash and other minerals necessary to maintain the blood in a natural state.

Symptoms of Scurvy.—In this disease we find, as might be expected, grave alterations of the body in consequence of the alteration of the blood. The first symptoms consist of pain in the legs and body, sallow complexion, swelling and bleeding of the gums, resulting in the loosening of the teeth and offensive breath, with general wasting of the body. The skin tissues also appear to participate in the general condition thus represented, for it is noted that the slightest injury is followed, in a typical case of scurvy, by the development of a sore or ulcer.

The disease causes death by the exhaustion it induces, while general dropsy usually appears, with heart or lung troubles. The treatment of this disease naturally consists in the administration of proper foods, amongst which fresh vegetable matters, with lime juice or lemon juice, are freely given. Later on the diet will consist of nourishing material. Milk may also be given. Of old, before the cause of scurvy was well understood, sailors when returning attacked from a voyage were in the habit of adopting at once a diet of which fresh vegetables formed a prominent feature.

Scurvy in Infants.—There exists a condition represented in infants known as *infantile scurvy.* This condition is associated with the disease known as *rickets*, an ailment of which the chief symptom is seen in deformities of the bones. An infant so affected is seen to exhibit weakness and pain in its legs. The slightest movement may cause the child to cry. The joints of the legs are noted to be swollen. On the skin an eruption appears, with small patches underneath from which blood is effused. A spongy condition of the gums is also noted. Physicians to-day clearly recognise that in such a case an erroneous diet must also be held to lie at the root of the child's trouble. It occurs typically in hand-fed infants brought up on infants' foods. It is not intended by this declaration to assert the opinion that the use of infants' foods is in itself necessarily injurious, but when these foods are used to the complete exclusion, or at least

to the exclusion in greater part, of *milk*, which is the child's natural food, scurvy is apt to be developed. Such cases are curable on the common-sense principle of a return to the natural diet of the child. Fresh milk must be given along with a certain supply of the juice of fresh meat, and also a certain amount of mashed potatoes. Lemon juice or lime juice must also be administered.

A New Theory.—We may here refer to a recent opinion which has attributed scurvy, in part at least, to the use of foods which have undergone injurious changes in the way of decomposition. A series of experiments was carried out whereby the administration to monkeys of such foods resulted in the production of the scurvy condition. Probably, however, these experiments simply go to prove that an alteration in the diet of the character already described, namely, some alteration in the amount and quality of the mineral matters it contains, would suffice to explain scurvy arising from these latter conditions.

RICKETS

Rickets proper is a disease of early childhood, and exhibits as its chief characteristics an imperfect bone-formation, the result being that the bones, especially of the lower limbs, exhibit serious deformities which may remain of a more or less permanent character. As in the case of scurvy, this disease appears to depend upon the administration of improper food. Some physicians lean to the opinion that rickets is a disease which, if not actually inherited from the parents, may present us with an illustration of an ailment, the development of which is at least favoured by the parental influence. We may, however, assume here that rickets is caused directly by the use of improper kinds of nourishment for the child. If it be true that the parent exercises an influence in the development of this ailment in the offspring, we may suppose in turn that if the child even in that case be supplied with proper food, its body is unable to utilise such diet in a perfect manner. Rickets is apt to appear from the sixth month of life up to the period of two years or two and a half years. Boys and girls appear to be equally affected, and with respect to the question of heredity it may be added that the general trend of medical opinion inclines to the belief that the child is more likely to develop this variety of constitution where the mother has similarly suffered than where the father has been affected.

Deficient Diet.—An authority on children's diseases asserts that where a diet is deficient in fat and in nitrogenous matter (represented

by the curd of milk and similar substances), there will be every probability of rickets being developed. In a woman who has borne many children, the births rapidly succeeding one another, the milk exhibits a deterioration in quality, and this alteration will correspond very largely with the deficiency in the two elements just named.

The use of *children's foods*, already alluded to in the case of scurvy, along with a deficient amount of *milk*, is no doubt also a prominent factor in inducing the disease. We must take into consideration other causes or conditions which indirectly favour the development of this ailment. These last are represented by poverty, overcrowding, and general unhealthiness of the surroundings amidst which many children are brought up.

The Symptoms.—A child affected with rickets shows a tenderness of the body at large, and an indisposition to walk about. A feverish condition exists, and this will be especially noticed at night. The skin of the child also acts in an increased degree and swelling is noticed, this symptom being specially observable in the case of the head and neck. The changes in the bones are seen in swelling at the ends of the long bones. The ankles, knees, wrists, and elbows all exhibit this symptom, and in the case of the head, the spaces between the bones of the skull show no tendency to become obliterated in a natural fashion by the formation of healthy bone. The teeth also exhibit a deficient development. The weight of the child's body acting on the leg bones causes them either to be deformed by outward or inward curvature. The ribs likewise undergo changes, and the breastbone becomes extremely prominent, developing "pigeon breast." There will also be seen in most cases curvature of the spine. The pelvis or haunch may be seriously affected, and in event of a female child growing up to adult life, the process of childbearing from this latter cause may be complicated by many dangers.

Treatment.—The treatment of this disease is naturally directed towards careful attention to the feeding of the infant. If children were properly fed upon the milk of a healthy mother or upon cow's milk suitably diluted, fewer cases of rickets would be observed. Over-suckling of children must be prevented, the mother's milk decreasing in quality according to the lapse of time after the birth period. Pure air and general healthiness of the child's surroundings form important items in the treatment. A sufficient amount of fat must be administered with the food. Cod liver oil and Virol present excellent means of securing this important addition to the dietary.

Fig. 47.—Treatment by Röntgen Rays at St. Bartholomew's Hospital.

CANCER

There can be little doubt that cancer represents a disease markedly on the increase in all civilised countries. Whilst a certain part of this increase may be accounted for on the ground that greater care has of late years been taken in the recognition of the disease, and in the proper certification of deaths from this cause, such features are incompetent to account for the total increase. Cancer appears to consist of an ailment the most marked characteristic of which shows itself in an alteration of certain *living cells* of the body, whereby they tend to grow and encroach upon their tissues and to destroy the latter. Also from a cancerous growth cells may be transferred by the blood or absorbents to other organs and there produce new development, or, as they are called, "secondary growths." It is this likeness of cancer cells to those which constitute the natural elements of the tissues amidst which the cancer is found, that forms one of the most interesting and at the same time puzzling features of this disease. The real problem of the cause of cancer consists in the ascertaining of the particular conditions, in view of which the ordinary cells of the part should acquire an abnormal power of breeding, multiplying, and thus destroying the adjacent tissues.

A Malignant Trouble.—Cancer presents us with a disease which is termed *malignant* in character. It is so named because its general tendency is to destroy the parts around and to shorten life. In this respect a cancerous tumour is of very different nature from, say, one we term of simple character. This latter variety of growth is represented by an ordinary *fatty tumour*, which has no tendency to spread beyond its site, and does not affect other and distant parts of the body. At the present time we are therefore ignorant of the cause of cancer, although research is actively proceeding in Great Britain, America, Germany, and other countries.

A Theory of Cancer.—An interesting view of the cause of cancer has been presented in the shape of considerations which have reference to the *development of the body*. A human body, like that of every other animal, springs from a single cell. This cell is of course a living particle, endowed with the potentialities of development, whereby it can form the entire frame. In the earlier stages of its development this germ-cell gives origin to a number of other cells. One of these may be said to represent the real germ of the body, the others going to form the reproductive materials out of which, in the future body, new animals will be developed. If we suppose that all of these latter cells (which we may call *generative cells*) remain in the

generative organs and devote themselves to the work of reproduction, the process of natural development would thus be properly and naturally carried out. If, however, certain of these "generative cells" adopt a wandering life, and migrating from their proper position in the body settle down in other organs, we may find in this fact an explanation of cancerous development. The tendency of each of these wandering cells would be that of endeavouring to carry out its own particular function, that of body-formation. This duty it would perform naturally if placed in its own and proper environment. But when such an errant cell finds itself in a distant organ (such as the liver or breast), and when, from one condition or another, some irritation of the part occurs, such a cell, developing under improper surroundings, it is held, may give origin to a cancerous growth. Cancer of the female breast is known very frequently to arise from the result of a blow or other injury. On the theory just noted, the effect of the blow might be supposed to excite the action of the wandering cells situated in the breast, and in this way to cause them to produce the new growth we term a "cancer."

A Cause of Growth.—Incidentally it has been supposed that one favouring cause of these generative cells, wrongly placed in the body, causing cancer, is represented by the secretions of certain glands acting as favouring influences in stimulating their growth. It is a curious fact that removal of a woman's ovaries in many cases appears to have the effect of arresting the growth and development of cancer in the breast. This result may be explained on the theory in question by assuming that when the ovaries were removed the wandering cells were deprived of the particular secretion necessary for their development in the unnatural situation in which they existed.

Cancer Cure.—*The cure of cancer* at the present time is practically limited to the art of the surgeon. Early removal of the cancerous tumour before it has had time to exert an influence on surrouding tissues forms the sheet-anchor of treatment.

The influence of *light rays*, applied by means of the *Finsen* treatment, has been assumed to be capable of affecting cancer in a favourable manner, whilst the application of the X-rays is at the present time also being tried experimentally. Radium rays are also being used by way of ascertaining if any arrest of development of a cancer can be procured by their means. Further research will demonstrate the value of such experimentation.

Lupus.—A disease allied to cancer in its nature is that known as *lupus.* This disease appears to be more common in women than in men. It generally affects the nose, but it may appear in other regions

FIG. 48.—LUPUS CASES BEING TREATED BY THE FINSEN METHOD.

of the body. Here, also, we are met with a disorder producing a destruction of tissue. But an important difference exists between lupus and cancer in respect of the slow action of the former ailment. Lupus has been regarded as being intimately related to scrofula and tuberculosis. By some physicians it is regarded as a local manifestation of the latter disease. Very excellent results have been produced in the case of lupus by exposing the tissues to the Finsen rays. Lupus may be regarded as a disease indicative of a low vitality, hence an important feature in connection with the treatment is the adoption of strengthening measures calculated to brace up the constitution at large.

THE LIGHT TREATMENT OF LUPUS AND OTHER DISEASES

In connection with the treatment of *lupus*, *cancer*, and diseases of allied nature, some important experiments, as already noted, have been made of recent years in connection with the employment of electric light allowed to play on the surface of the skin by way of bringing about a cure. It may be said at the outset that no exact evidence of the power of any light rays whatever to cure or to affect *cancer* has been obtained. We may therefore fairly assume that as regards any curative value which light may possess when applied to cancerous growths, such a topic presents itself as one requiring more thorough examination. The case is different when we come to consider *lupus*. Professor Finsen, of Copenhagen, was the first to propose the application of light rays to the treatment of this disease (Figs. 47 and 48). Several British hospitals, and most notably the Middlesex Hospital, in London, and the London Hospital, have established installations of the Finsen apparatus. What is known as the "Finsen electric arc lamp" was first introduced at the London Hospital. It is probably the best known form of this description of apparatus. It may be added that Her Majesty Queen Alexandra, who takes a deep interest in the application of her countryman's discovery to the cure of lupus, herself presented the installation to the hospital. Each of these lamps represents 10,000 candle power capacity, and are said to consume 75 ampères of current at a pressure of 60 volts. The light is filtered through different lenses for the purpose of absorbing so much of its heat, and is then focussed on the person affected. The focus of light thus produced is, of course, of small extent, hence its application for the cure of diseased surfaces is apt to be of a somewhat extended character. It is said that in severe cases as many as two hundred

separate applications require to be made in order to effect healing changes in the diseased part.

A more recent invention of this kind is that where electric lamps are used, the light being in close proximity to a crystal lens. Here the heat rays are kept off by means of a screen through which water passes, the crystal being placed in the centre of the screen, and water made to circulate through this latter part. The diseased part is practically brought in close contact with the lens. It appears to be essential for the action of the light rays that the diseased part should be deprived of as much blood as possible, and the use of the lenses seems to bring about this end. What is known as the "Cox Lupus Lamp," otherwise the "Heathcote," presents us with an invention in which the carbons are maintained in a cool state by means of water-jackets.

It may be mentioned that those curious light rays known as the X-rays, by means of which the interior of opaque objects may be photographed (an application well seen in the detection of fractures and other injuries of bones), have also been used for the cure of lupus. Several authorities seem to accord a preference to the X-rays over the ordinary electrical waves for the purpose of treating lupus. For hospital use a lamp is used, the rays of which pass from a spark which exists in a form of rapid oscillation between two metal points. The rays are produced in this way in a manner not at all unlike that in which the waves used in wireless telegraphy are evolved. An authority speaking of the action of these rays, and debating the question whether they are due to purely chemical effects or to electrical effects, or to a combination of these two, says that "it must be admitted, apart from whatever chemical or electrical property the X-rays may possess, that the sum total of their action is that of an irritant. Now, if we irritate a certain part of the body by X-rays, we produce ultimately a simple focal (that is, localised) inflammation. Inflammation means the determination of so much blood to the part. Owing to the increased volume of the blood the white blood corpuscles accumulate in large numbers, and finally an arrest of the circulation takes place. The circulation being thus affected, the diseased part practically may be said to die for want of nourishment. We may suppose that the X-rays thus affect the essential tissue-forming elements of the body. They, as it were, separate off affected parts, and these parts having their nourishment interfered with exhibit a tendency to cure."

Light and its Effect.—In connection with this subject it may be mentioned that ordinary white sunlight is really composed of different coloured rays, familiarly seen in the rainbow. Each of the

rays of light exhibit certain definite properties. Yellow rays chiefly give us ordinary light, whilst the red rays emit heat. The blue rays and the violet rays are known as "actinic" rays, and possess properties which are of course valuable in so far as photography is concerned. These actinic rays represent the kind of light which is chiefly used in the treatment of lupus. The patient has applied to him rays from an arc lamp which are, as we have seen, focussed on the seat of the disease, and this light being filtered through a lens, the heat rays are absorbed, allowing the other rays only to pass through. Occasionally an arc lamp is replaced by the spark from an induction coil giving violet rays, a condenser being employed in order to concentrate the rays. Other forms of lamp have been designed for carrying out the Finsen treatment. Thus small arc lights are often used. These are placed close to the diseased parts, being separated from them by diaphragms or screens of quartz and by a stream or layer of water, which cools the light by the absorption of the radiant heat rays.

Summing up this subject, we may say that for the cure of lupus the light treatment has been proved to be highly successful in appropriate cases; but the value of this cure as applied to cancer itself is a matter for future investigation.

SCROFULA

This is an ailment now regarded as being related in a very close and intimate fashion to tuberculosis itself. Of old it was known as "King's Evil," and was believed to be cured by the touch of a royal hand. By some authorities it is considered as representing a modified form of this latter disease, manifested especially by its tendency to develop slowly and to attack specially the joints and the lymphatic glands. The fact of the relationship between scrofula and consumption is largely borne out by the fact that scrofulous or "strumous" children are apt to appear as the progeny of consumptive parents. The scrofulous child may exhibit a slight figure, clear complexion, with very fine silky hair, and be of a bright and cheerful disposition. On the other hand, we may find such a child to show a heavy build, the head large and the joints enlarged, with coarse thin hair and with dulness of intellect. As a condition affecting the body generally, scrofula most frequently makes its appearance in the lymphatic glands already mentioned. These glands are situated in many parts of the body, but those of the neck and under the jaw are the most common seats of attack. The glands swell, undergo a slow-proceeding variety of inflammation,

and finally suppurate and then break and discharge through the skin, leaving in many cases distinct scars. If the scrofulous condition is more widely distributed through the body, we may find disease of the bone induced, and especially in the neighbourhood of joints, which latter may have to be surgically treated.

Treatment.—The *treatment* of scrofula at large is that of improving the general condition of the body, as in the case of tuberculosis itself. All the surroundings of the patient must be made of a thoroughly healthy character. The food must be supervised, and a sufficiency of fat administered. In connection with the general treatment of this disease, it may be noted that a pure air, and especially that of the sea and of a bracing coast-line, with sea-bathing, is likely to be of the utmost advantage. The administration of cod liver oil forms also an important item in the treatment of scrofula. This valuable adjunct of food in the case of scrofulous persons should be united with iron. A favourite mixture for use by scrofulous persons is six ounces of cod liver oil, to which is added three drachms of the syrup of iodide of iron and one ounce of gum mucilage; a dose of this mixture for use by an adult will be one tablespoonful thrice daily after food. In the case of *scrofulous joints*, when the inflammation and swelling is marked, they must be put in appropriate splints and kept at rest. When suppuration takes place in the joint, the advice of the surgeon should be at once sought; indeed, the case of any swelling of a joint occurring in a scrofulous child or person should be an indication of the imperative need for medical aid.

The Glands in Scrofula.—With reference to the treatment of the *enlarged glands* which occur in scrofula, it may be here mentioned that the old practice of poulticing such glands by way of "bringing them to a head," as the phrase goes, through causing suppuration and their subsequent bursting, has now been superseded in medical practice by a much more satisfactory procedure. When evidences of enlarged glands begin to appear, the child should be taken to a surgeon at once. A simple operation can be undertaken for the removal of these glands, and of thus avoiding the scars and deformities which are certain to result if they are allowed to break and discharge. Another point of much importance in connection with this latter advice is found in the fact, that by the removal of these scrofulous glands fresh infections are capable of being prevented. Each gland may, in fact, be regarded as a kind of focus or point of origin for new departures on the part of the disease. Their removal therefore tends to abolish a source of secondary infection, besides doing away with the local irritation they are certain to cause.

SYPHILIS

A mere mention may here be made of *syphilis* as a constitutional disorder. Seeing that this ailment will be fully treated in the section of this work devoted to venereal ailments, it may only here be remarked that *syphilis* is a disease which results from a specific poison or germ, usually acquired through contact with the generative organs of a previously affected person. It may also be conveyed through contact with the mouth or lips of such a person, and in other ways.

Syphilis forms of itself one of the most serious disorders which can affect the human race. It is an ailment of widespread character, being found not only amongst civilised races, but also amongst savage peoples. Left to itself, it produces ravages on the body scarcely inferior to those caused by cancer itself, affecting not merely the tissues of the skin and internal organs (markedly the brain), but even inducing serious disease of the bones when it is present in an aggravated form.

One of the important features of *syphilis* is that it is distinctly liable to be of inherited nature. Syphilitic children suffer severely from its presence, and women who have been infected by this ailment are extremely liable to the occurrence of abortion.

OBESITY, OR EXTREME CORPULENCE

Extreme stoutness may in itself constitute a source of danger. Not only is this condition attended by many disadvantages depending upon the extreme weight of body, but the subject thereof is also much more liable to the attack of certain diseases, and, what is equally important, he exhibits a much more lowered resistance to certain ailments, and may more readily fall a victim to them than his spare neighbour. It is undeniable that personal constitution forms a very important factor in connection with the development or absence of obesity. Certain human beings may be well compared to Pharaoh's "lean cattle," in that no amount of feeding can induce the corpulent state. In others again, the obese condition is rapidly produced. The influence of a parent stock has here to be taken markedly into account, seeing that in some families fatness would appear to "run in the blood," just as in others spareness forms a characteristic feature of the family group. Possibly an intermediate source of beings exist who may develop stoutness on account of unwise feeding, these last

being probably the subjects most easily cured by a return to a sensible mode of life. In many individuals there exists a tendency to develop additional stoutness of body on attaining a certain age. This increase hardly entitles us to regard the individual as necessarily the subject of disease, but there can be little doubt that in the case of certain persons an extreme development of the fatty tissues of the body may constitute them subjects for the attention of the physician. Such persons may well re-echo the words of Hamlet, and desire that "their too too solid flesh" would "melt."

The Causes of Fatness.—Having regard to the *causes* of obesity, these may be ranked under two heads. In the first instance a man may acquire excessive fatness from taking too much food, associated with the condition represented by too little exercise. An author has well remarked that "it is difficult to make a man of forty understand that he cannot properly utilise and adequately dispose of as much food as he used to do when he was thirty, or a man of fifty when he was forty, so that a diet which would not be in any way excessive at the former age becomes distinctly excessive and provocative of undesirable corpulence at the latter."

Here a simple cause of obesity is an excess of bodily income over bodily expenditure. The man is accumulating a store of unused material appearing in the shape of fat, and his degree of stoutness will no doubt be determined by his personal history, or by the fact that he is descended from a corpulent stock or the reverse. If we add to this condition an excess of food over the wants of the body, or lack of sufficient exercise, we are presented with the common conditions which cause obesity. On the other hand, it may happen that a person who does not exceed what is proper and natural to his age in the way of diet may, by an unwise selection of foods, induce corpulence. Hence it is necessary for us to glance briefly at the foods which are likely to induce over-stoutness of the body.

Sex and Nation.—A curious fact is that sex appears to exert a comparative influence in determining the development of corpulence. Women are more subject to this ailment, if so it can be called, than men. When women attain the age of from forty to fifty they frequently exhibit a decided increase of weight. Certain nations are also given to the development of excessive stoutness. The Hottentot may be quoted as an instance of a race exhibiting this tendency on the part of a semi-civilised or savage nation; whilst the German and the Jew may also be cited as examples of civilised peoples in whom a tendency to excessive stoutness is very liable to be represented.

In so far as obesity may be laid down to the accumulation of excessive fat in the body, we may assume that in the average healthy

man this tissue will comprise about one-twentieth part of the weight of the body. This, probably, is slightly exceeded in the female. In typical cases of corpulence, however, the amount of fat may form one-half or even four-fifths of the bodily weight.

Obesity and Health.—The influence of obesity on the general health is very marked. If a want of exercise be characteristic of many of these cases, it can readily be noted that as the weight increases there is less disposition for exertion. There will also be considerable disturbance of digestion, and unquestionably a greater amount of work is thrown upon the kidneys of the obese person. A more serious danger is the effect of obesity upon the heart. The muscle of the heart is singularly liable to undergo that process known as *fatty degeneration.* Here we find that so much of the actual muscular fibre of the heart is replaced by fatty material. A heart in this condition approaches in its nature to that of the over-fed ox, in whose case we perceive the heart loaded with fat. The duties of such a heart cannot, of course, be perfectly performed, and any additional strain made upon it may result in serious consequences in the way of heart failure. It may also be said that with respect to the general condition of body induced by fatness, there is a greater tendency on the part of the obese person to attack from lung troubles, and what is equally to the point is that he is less likely to recover from them. In a word, corpulence is a condition which lays its subject open to the attack of disease in general. Hence it is a state which well deserves attention in respect of the details calculated to effect its removal.

Fatness and Food.—Dealing with the subject as it alone can be perfectly studied, namely, from the food point of view, it is necessary here to note that certain foods are typically fat-producers. These latter foods are *starches and sugars.* As all starch consumed as food is converted in the body into sugar, we may simply style such foods as *sugars.* Fat itself, unless taken grossly in excess, cannot be considered to be a source of fat formation. A great physiologist has summed up this truth in the words that no fact in physiology is more clearly demonstrated than the formation of fat from that which is not fat. That starches and sugars are the chief source of fat formation has been proved experimentally. Fattening in domestic animals is known to take place most effectively when large quantities of starch are given to them in the way of food. The fat of the milk of the cow fed on grass can only be formed from the starch contained in the grass. Bees make wax, which is a form of fat, from the sugar of the honey they feed upon. The negro eating large quantities of sugar develops similarly a fatty constitution.

With reference to the consumption of sugar by the fatty individual, a calculation has been made of a highly interesting kind. An author remarks that if an individual who shows some tendency to increase of weight, and who may feed moderately, takes every day one half ounce of sugar only, in excess of that which is required, he may each year, if this excess be converted into fat, store up 11 lbs. additional weight; whilst in five years he will have this increased to the extra amount of 55 lbs. or more. It is not to be denied that fatness may result in certain cases from causes other than those dependent on an excess of fat or the improper use of certain kinds of food. It is not an uncommon thing to note an *anæmic girl* exhibiting a stout or corpulent body. Here no excess of food may be taken, but in consequence of a want of combustive power, so to speak, in the frame, whereby food is burned up or oxidised in bodily work, the body tends to increase unduly. The administration of iron in such a case (the typical remedy for anæmia) increasing the oxidising power of the blood, tends to cure both the anæmia and the unusual stoutness.

The Cure of Corpulence.—These considerations lead us towards an appreciation of the cure of obesity. It may here be said that all empirical or quack cures for the reduction of stoutness may be utterly disregarded. If any of these prove successful at all, it will be found that their authors are acute enough to give directions for diet and feeding, in addition to the administration of their special remedies. Success here is clearly due to diet, not to drugs, and this rule should be kept in mind by obese persons.

A drug which has been supposed to exert some influence in diminishing fat formation is the extract of seaweed. This substance contains iodine, but its administration cannot be recommended as effective in the first instance, and it would be hopeless to expect any definite results where this substance is used without the modifying influence of diet.

The Banting Cure.—Fat cures bulge largely in number in the history of medicine. One of the most famous of these was that known as the *Banting cure*. Mr. Banting was a London undertaker who had attained an undesirable bulk of body. His medical man, Mr. Harvey, advised him to adopt a particular diet, with an increased amount of exercise. In the "Banting diet" there is represented an increased amount of animal food, whilst starch and sugar as far as possible are excluded. Mr. Banting's diet as regards its details consisted of the following items. He breakfasted at 9 o'clock, and consumed from 5 to 6 oz. of boiled fish or of meat; pork and veal were excluded. In addition, he had either a biscuit or 1 oz. of dry toast. A cup of tea or coffee was allowed, no milk or sugar being used. He dined at 2 o'clock, and

was allowed fish or meat. Fishes containing a large amount of fat were forbidden, these being salmon, herring, and eel, whilst pork and veal were again prohibited. He was allowed poultry or game. The total amount of meat consumed at dinner amounted to 5 or 6 oz. in weight. Green vegetables were permitted, but potatoes, parsnips, carrots, turnips, and others containing starch, were forbidden. The bread consisted of 1 oz. of dry toast. Cooked fruit he was allowed, no sugar being allowed in its preparation. With regard to his liquors, Banting was permitted to take 1 oz. of claret or sherry as his dinner drink. His tea was taken at 6 o'clock. He had a large cupful of tea without milk or sugar, and cooked fruit to the extent of 2 or 3 oz. was allowed with a rusk. At 9 o'clock supper was given, when meat or fish similar to his dinner rations, to the extent of 3 or 4 oz. in weight, were permitted, and 6 or 7 oz. of claret or sherry and water figured in the diet list. The result of this diet was that in a year Banting reduced his weight from 14½ stones to a little over 11 stones. Additional exercise, including rowing, was duly practised.

The Ebstein Cure.—In another system of diet known as the *Ebstein method*, more fat is allowed than in the ordinary treatment. The administration of fat in this system is regarded as tending to the burning of or oxidising of any excess of fat, but, as in the Banting system, all starch and sugar are practically forbidden, with the exception of perhaps from 3 to 3½ oz. of bread per day.

A Comparison of Methods of Cure.—If we make a comparison between various modes of fat treatment, we find an authority stating that the amounts of nitrogenous food, of fats and starches and sugars, may be stated as follows :—In the *Banting treatment*, 6 oz. of nitrogenous foods, ⅓ to 1 oz. of fat, and 2¾ oz. of starch and sugars constituted the amounts which may be regarded as having been placed daily at the service of the body. The *Ebstein treatment* diminishes the amount of nitrogenous matter and increases the amount of fat. According to this latter method, 3½ oz. of nitrogenous food per day, 3 oz. of fat, and 1¼ oz. of starch and sugars represent the daily rations. In yet another system the amount of nitrogenous food is increased to 5½ oz. to 6 oz. ; the fats amount to about 1 oz. and the starches and sugars to about 2¼ oz. or 3 oz. All of these systems depend for their success upon the reduction of starches and sugars in their dietary ; but it must also be clearly recognised that the success of any treatment will depend, not on the regulation of the food alone, but also upon the taking of a certain amount of exercise and the regulation of the body's habits at large.

Some other Hints. — Certain other details may be here appended by way of noting recent developments of the treatment

of obesity. Some physicians recommend that the diet should be as *dry* as possible. The limitation of fluids consumed appears to be, in certain cases, followed by satisfactory results ; but at the same time the limitation of starches and sugars has here been duly enforced along with a sufficiency of exercise.

Alcohol.—It may be added here that as regards alcohol, spirits, beer, and effervescing wines are all forbidden. As we have seen, the lighter and drier wines of the white or red variety, diluted with water, may be given.

The Salisbury Cure.—What is known as the Salisbury treatment of obesity has been recently practised, in America especially. It consists in the administration *of large quantities of butcher meat* as the sole article of diet. This meat, it is recommended, should be chopped fine, and should be of lean character. No other article of diet is to be taken. The amount given is 1 lb. of lean rump steak for breakfast and lunch for fourteen days, and for dinner during this period 1 lb. of grilled fish (cod) and 1 lb. of steak. During this period, one gallon of hot water is taken in twenty-four hours, with a small glassful of whisky in cold water at bedtime. For the next twenty-one days the diet is altered and varied (including lean mutton chops, white fish, and rusks), and only four pints of hot water are consumed daily. Then for thirty-one days thereafter the water is reduced to one quart ; the diet is further extended, and five grains of bicarbonate of potash are taken night and morning. The treatment lasts nine weeks or so. Two hours after each meal hot water is advised to be taken in unlimited quantities, or at least to a large extent, the object of this latter procedure being no doubt that of securing an efficient flushing of the kidneys so as to obviate any risk of inducing kidney troubles from the effect of the excess of nitrogenous food taken. This method is said to have been practised with great success in a number of cases ; but it is not one which should be undertaken without the advice and supervision of the physician.

RHEUMATISM

This disease may be described as one of constitutional kind, and it presents certain resemblances to *gout*, although the two diseases are in their nature essentially distinct. The phrase *rheumatic gout* has been applied popularly to cases of chronic or lasting nature in which the joints have come to be more or less permanently deformed and affected. By the term "rheumatism," as ordinarily used, we mean to indicate the acute form of the complaint otherwise known as *rheumatic fever.* This disease, however, may readily pass into a

chronic form, in which, as already mentioned, the joints may be more or less affected, while sundry other symptoms and complications are apt to mark the presence of the ailment in its lasting form. Certain other varieties of rheumatism have been described. Thus a form of the complaint, or of an ailment which is practically similar to rheumatism itself, is apt to supervene on the venereal trouble, known as *gonorrhœa.* This variety is therefore known as *gonorrhœal rheumatism.* Finally, we find yet another ailment of rheumatic type known as *muscular rheumatism.* Of this complaint the best known examples are found in the common ailment known as *stiff neck*, due to exposure to cold, *lumbago*, and *chest pain;* this latter being limited to the walls of the chest, and specially affecting one or more of the spaces between the ribs. Rheumatism is essentially a disease whose seat of attack seems specially to be the structures which enter into the composition of joints; but an important fact should also be borne in mind in connection with this ailment—namely, that it is one singularly liable to be attended with complications involving disease of other organs. One of the most important of these complications is represented by the effects which are apt to follow an attack of rheumatic fever *upon the heart.* Hence the physician must be always more or less anxious in his treatment of cases of this complaint to ensure that the heart as far as possible should escape being affected.

Its Causes.—The direct cause of rheumatism is undoubtedly *exposure to cold and chill.* It is one of those ailments to which, in a temperate zone, with changeable weather conditions represented, nations are particularly subject. There can be no doubt, also, that *dampness of soil* on which houses exist must be regarded as a contributing cause to the advent of this disease. It will be clearly understood that, as far as is at present known, there is no direct process of infection in rheumatism as in the case of any ordinary fever. At the same time it is necessary to state that the idea of this disease being due to the attack of some microbe or germ has been mooted. At present no evidence of direct kind can be quoted in favour of this theory.

Lactic Acid.—When dealing with the symptoms and causes of disease at large, it was pointed out that *gout* and *rheumatism* presented illustrations of ailments which were really caused through some condition or other of the body producing a special substance or poison which, acting after the manner of a poison, gives rise to the special features seen in each disorder. We have to deal in the case of both gout and rheumatism, therefore, with what may be called a perverted state of the body. Some product or other of bodily waste, or it may be some substance produced in the course of the digestion of food, which is normally used up or excreted from the body, may

well act as a disease-producing principle when its chemical relationship to the body is altered, or when, instead of being duly got rid of by the system, it is retained in the tissues. It so happens that in a case of rheumatism the particular substance to which the disease is regarded as being directly due is known as *lactic acid*, and in the view of a considerable number of authorities of high repute this acid may be regarded as unduly affected in respect of its production in excess by cold or chill or by damp soil, which we have seen to constitute a predisposing cause of the ailment. Rheumatism being essentially a disease of the poor, we may also have to take into account as predisposing causes poverty, want of sufficient nourishment, and other conditions only too frequently represented in the surroundings and life of the masses.

Inheritance and Rheumatism.—With reference to certain other conditions which appear to predispose towards a liability to attack by this disease may be mentioned *inheritance*. Without going so far as to assume that the children of rheumatic parents must necessarily develop the disease, we may at least hold the existence of a greater liability in their case to attack than in the children of parents free from any suspicion of the ailment. First attacks of this disease are said to be most frequent between the ages of sixteen and twenty-five, and males appear to be more subject to it than females.

Lactic acid itself is a substance naturally formed in the body as the result of muscular action. It may therefore be said to be a perfectly legitimate waste product of our vital actions. In the case of health this acid is assumed to be excreted from the body by means of the skin, or may be otherwise destroyed chemically. If we suppose that owing to the influence of cold, chill, or allied conditions, the work of getting rid of this acid is interfered with or suspended, we then find it accumulating in the blood. It thus appears as a poison conveyed by the blood to the various joints, where eventually its presence gives rise to the ailment we know as *acute rheumatism*.

Other views of the causation of rheumatic fever have referred its existence to the direct influence of the nervous system which has been affected through the chill received by the surface of the body. This latter view, however, does not take account of what seems to be an undeniable fact—namely, the presence of an excess of lactic acid. It might, of course, be held that such erratic nervous action due to cold would interfere with the excretion of the acid, and the second theory might in this way serve as an explanation of the cause why the process of excreting the acid should be interfered with.

Allusion has already been made to the idea that the disease might be due to *germ attack*. There appears to be, however, as has already

been remarked, no exact evidence to hand warranting support of this view.

Symptoms.—An attack of rheumatic fever begins with a general feeling of weariness, stiffness of the muscles and joints, a want of appetite, and frequently with sore throat. The joints soon swell, and develop an extreme degree of tenderness and pain. The most prominent joints affected in an ordinary attack are the knee, wrist, elbow and ankle, and an extremely important feature of this complaint is found in the fact that the pain and swelling may pass from one joint to another. As the disease progresses, the temperature will be found to rise, with daily variations. It may attain the height of 104 degrees Fahr. in an ordinary case, although higher limits have been reached. It need hardly be pointed out that when the temperature in this fever rises to 107 or 108 degrees the worst results may be feared. The pulse is of a full and bounding character. The skin action is peculiar; the patient perspires very freely, but the sweat possesses a very distinct, peculiar, sour or acid odour, which is recognised by the physician and nurse as thoroughly characteristic of the ailment. Constipation will be found as a rule, and the urine will be high coloured. It is not passed in the usual quantity, and when it cools a deposit of minerals known as *urates* is found in it. *Urea*, which represents the last stage of the using up of nitrogenous foods in our bodies, is given off in very much increased quantity in acute rheumatism.

Complications.—It has already been remarked that this disease is apt to be attended by not a few serious *complications*. The heart has been mentioned as specially liable to attack. The effects of the disease on this organ are practically those of inflammation of the heart-tissue; this process affecting not merely the *pericardium* or bag of the heart, but the substance of the heart itself and also its valves. Other complications of rheumatism may be found in the shape of an attack of *pleurisy* or *bronchitis*. The average length of an attack of acute rheumatism may be set down as lasting from four to six weeks. Great care in nursing is necessary, seeing that a relapse may occur through even a slight chill being sustained.

Gonorrhœal Rheumatism.—In the case of gonorrhœal rheumatism we find a peculiar ailment, apparently directly or indirectly set up by the presence of a discharge from the generative organs. It is much more commonly seen in men than in females, and probably occurs most frequently when the subject of the ailment just named has acquired a chill. The usual seat of this variety of the ailment is the knee, which in a typical case may swell to a considerable extent. Other joints may also be affected, whilst in

this ailment the muscular tissues are also liable to exhibit rheumatic symptoms.

Treatment.—The *treatment of acute rheumatism* in modern times is largely founded upon the discovery that *salicin* and *salicylates*, products consisting of the principle of the bark of the willow-tree, or in combination with other substances (such as soda), exert a very decided influence on the course of rheumatism. By many physicians, indeed, salicin and its compounds are regarded as *specifics* in this disease in the same sense in which we find mercury a specific in syphilis, or quinine in malaria. If salicin be used, the dose would be twenty-five grains administered frequently, *i.e.* each hour or every two hours, until the temperature of the patient has fallen to its natural or nearly natural extent. Thereafter the doses are given less frequently. If the salicylate of sodium be used, it may be given in water in a dose of twenty grains every two hours. If salicylic acid be administered, the dose will be twenty grains, administered as in the case of the other drugs just described. Forty-eight hours treatment of this kind will probably be found sufficient in an ordinary case for the lowering of the temperature and the modification of the pain. Thereafter a dose of the medicine every four hours will be sufficient for the next two days, and afterwards at lengthened intervals, namely, every six hours for the three or four days succeeding.

The physician will of course be the proper judge of the length of time during which this treatment will last, but it is usual to continue the salicin or salicylates for a week or so longer, giving a dose of ten grains three times a day. A tonic will be required later on in order to brace up the patient in this disease. A mixture of iron and quinine appears to act most favourably. Such a tonic may be composed of eight grains of sulphate of quinine, sixteen grains of sulphate of iron, dilute sulphuric acid eight minims, and water eight ounces. This should be labelled: "Two tablespoonfuls to be taken three times a day between meals."

It is held that if the treatment thus described be adopted very early in the course of rheumatic fever, it has the effect of effecting or preventing the attack of the disease on the heart. The physician will probably duly note that the drugs in question do not accumulate in the system, and his guide in this respect will be the testing of the patient's urine when the salicylates are being duly and properly eliminated from the body. The addition of a little tincture of iron causes the urine to assume a purple colour.

The Cold Bath.—The use of the *cold bath* in acute rheumatism can only be justified by the advice of the medical man; but it may

be mentioned that this mode of treatment may be used by the physician when, in consequence of an extremely high temperature, a serious result is anticipated.

The Alkaline Treatment.—It should be noted that before the salicylic treatment of rheumatism came into vogue, rheumatism was largely treated by the administration of *alkalies*, that is to say, substances which, like soda and potash, are the opposites of acids. These render the blood alkaline. In this way it was believed that the effects of the lactic acid could be counteracted. There can be little doubt that this mode of treatment possesses its own advantages, although taken as a whole, the curative effects are not so quickly manifested as in the case of the treatment above described. One mode of administering alkalies has been described as that of administering forty grains of bicarbonate of potash every three hours in soda-water. Some physicians prefer to add the bicarbonate to water in which a little citrate of ammonium or citric acid has been dissolved so as to form an effervescing draught. This treatment is continued regularly until the active symptoms have been mastered. In addition to this treatment, plenty of soda-water with milk or with fresh lemon juice is usually given, and persons bear this form of treatment well, unless heart troubles supervene. It is generally recognised that if the alkaline treatment tends to produce looseness of the bowels, it should be discontinued.

Blistering.—In olden times *blistering* was a remedy frequently adopted for rheumatism. Blisters were applied to the affected joints. It is claimed for this treatment that in some cases it tends to shorten the attack, and it certainly has the merit of relieving pain; but probably in face of the many advantages of the salicylate treatment, blistering has naturally fallen into the background in modern times.

Local Treatment.—With regard to *local treatment* of the joints, these must be protected by being wrapped in cotton wool, whilst absolute rest is of course necessary. Any joint specially affected should receive support. It is usual also to use *lotions* of various kinds by way of relieving the joint pain. Warm water to which carbonate of soda is added may be used for sponging the joints, care being taken, of course, that no chill is sustained. Another lotion much used in the treatment of this disease consists of one ounce of carbonate of soda and six drachms of the liquid extract of opium dissolved in ten ounces of hot water. The mode of application of this lotion is by means of pieces of flannel soaked in it, these being placed on the affected parts and covered with oiled silk or gutta-percha to prevent the too rapid evaporation of the lotion.

Nursing.—In this disease *careful nursing* forms a most important element in the treatment. The nurse will require to possess a sufficient amount of strength in order that she may assist the patient in any necessary movement without causing him undue pain or discomfort. A narrow bed is best, seeing that it permits of access to the patient from all sides. It is probable that the nurse will cause the patient to lie between the blankets for the reason that this plan will tend to absorb the perspiration, and thus avoid liability to chill. The patient himself will also be clothed in flannel as a bedgown.

Diet.—An important part of the treatment of rheumatism is that which has reference to the *diet.* This topic may shortly be disposed of with the remark that the diet proper in a case of the kind we are considering is largely that administered in fever cases at large. The food should be administered on the "little and often" principle. No meat is to be given on any account, and milk will form the patient's sheet anchor. A little vegetable soup or chicken soup will form a valuable additian to his diet. Lemon juice may also be freely given, and later on in the case of a return to the ordinary diet such a procedure is best made cautiously by giving at first white boiled fish and boiled chicken, whilst at a succeeding period a little roast mutton may be added to the dietary. It should be borne in mind that as all meat forms an improper food in the course of this disease, eggs must be placed in the same category.

With regard to the treatment of *gonorrhœal rheumatism* much the same line is pursued as in ordinary rheumatism. Rest in bed, the application to the joints of soothing lotions and attention to the diet will probably suffice for a cure, but attention of course must be duly paid to any discharge of the kind already mentioned as probably constituting the active element in inducing this form of the affection.

MUSCULAR RHEUMATISM

Muscular rheumatism is a much milder form of the disease, but it is probably more frequently represented in persons of a rheumatic tendency than in healthy people. Cold, chill, or exposure to some draught or damp are the general causes. As has already been remarked, this affection may appear as *lumbago, stiff neck, chest pain,* and may also affect other situations of the body. Of these affections probably the most painful is *lumbago*, so called because it specially affects the muscles of the loins or lumbar region. There is an absence of fever in this ailment, although feverishness to a slight

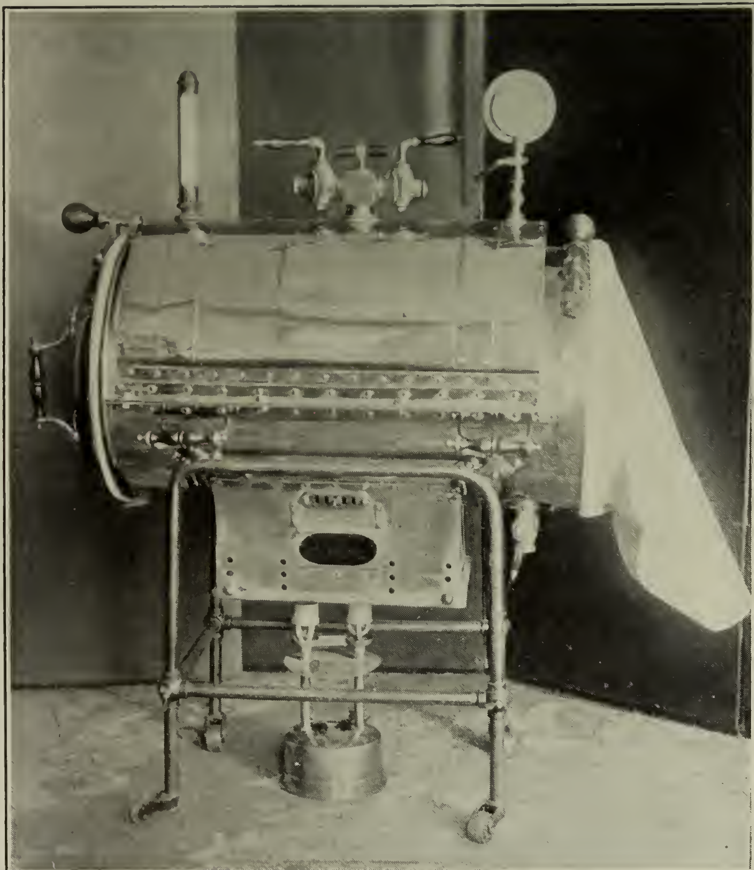


FIG. 50.—THE TALLERMAN APPARATUS FOR THE TREATMENT OF RHEUMATISM, &c.

FIG. 51.—A CASE OF RHEUMATIC GOUT LASTING EIGHT YEARS; PATIENT AGED SIXTY-NINE.

The upper figure shows effect of second application of the Tallerman treatment, and the lower figure the cured state with perfect freedom of movement.

degree may be present, especially in the case of nervous and irritable subjects.

Treatment.—A treatment of muscular rheumatism which may be very effective in slight cases is that by means of a Turkish or similar bath. If, as is likely, constipation is present, a saline purge should be given so as to clear the digestive system. If the muscular rheumatism is severe the salicylate treatment might be tried, but a remedy adapted for simple cases is that of giving from twenty to thirty grains of bromide of potash twice or thrice daily in water. This medicine tends to relieve the pain and also corrects to a certain extent the acidity, on the presence of which the ailment depends. In the case of severe pain, such as may be experienced in lumbago, the medical man is accustomed to inject morphia under the skin. In other cases *acupuncture* has been used. This process consists in plunging a needle into the muscles of the loins over the seat of the pain. In other cases relief is most readily obtained by the application of large linseed meal poultices across the loins. A little mustard may be sprinkled on the poultice to assist its action.

Hot fomentations are also used in varieties of muscular rheumatism. *Spongio-piline*, to be obtained from any chemist, may be wrung out of hot water, sprinkled with turpentine, and applied to the part, the piline being covered with thick bath towels to assist in retaining the heat.

CHRONIC RHEUMATISM

As has already been mentioned, an attack of rheumatism may fail to be cleared out of the system, as it were, and may thus come to leave permanent effects in the shape, chiefly of thickening of the joints. Those mostly attacked are the knee and ankle. In addition to the thickening, active symptoms may be experienced, the occurrence of these latter depending very often on changes of the weather. The familiar lines—

> "When doors and chairs begin to crack,
> Old Betty's joints are on the rack,"

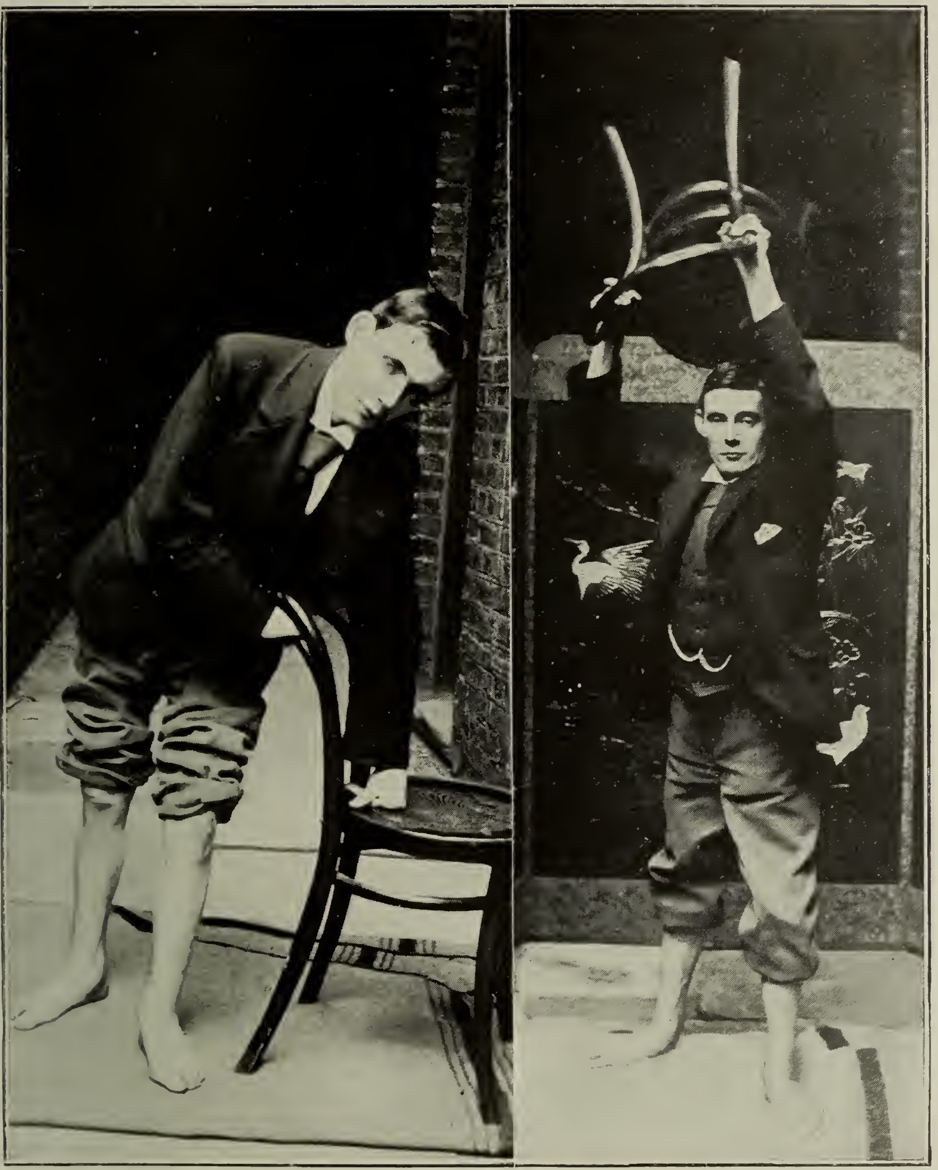
indicates very aptly the effect which variations in the air-pressure exert upon weak joints. The fluctuations of the barometer, indeed, might readily afford an indication of great accuracy respecting the condition of those persons suffering from the chronic variety of rheumatism. Patients themselves may even experience in affected joints sensations enabling them to foretell with a certain amount of

accuracy changes in the weather. This variety of rheumatism is more especially found in persons at and beyond middle life. It is not a disease dangerous in the sense in which the acute variety is to be regarded, for it does not exhibit any tendency to attack internal organs such as the heart; whilst fever is absent, and between his attacks, the patient may be fairly well.

Rheumatic Gout.—A variety of rheumatism which must also be noted here is that known as *rheumatic gout*, known to physicians as *rheumatic arthritis*. This disease is mostly found amongst the poor, and it is attended frequently with great alteration and deformity of the joints (Fig. 49). It is most common in persons above the age of thirty years. As it progresses the patient tends to become more and more helpless, and in a long-standing and typical severe case all power of movement may be lost on account of the deformity produced in the limbs.

FIG. 49.—Deformity of Fingers in Chronic Rheumatism.

The treatment of chronic rheumatism is largely that of supporting the vitality of the body. Those who can afford it are recommended by physicians to try the course of treatment adopted for this ailment at such places as Bath and Buxton in England, and Strathpeffer in Scotland. Abroad, such cases benefit from a residence at Baden Baden, Wiesbaden, and Aix-les-Bains. The salt baths of Woodhall, Saltburn, and Droitwich, in England, have also obtained a high reputation for the cure of rheumatism of the chronic variety. Medicines and drugs are hardly calculated to afford great relief in this condition. Iron and cod liver oil have been recommended as a bracing medicine, affording a certain amount of support to the system. If pain be severe, hot turpentine fomentations may be applied to the joints, whilst, where the patient is suffering from one of his bad periods, so to speak, salicylate of sodium may be tried. A prescription of the following kind is likely to prove useful here: Iodide of sodium, sixty grains; salicylate of sodium, sixty grains; phenazonum, sixty grains; aromatic spirits of ammonia, three drachms; water up to six ounces. Label: "A tablespoonful to be taken in half a tumblerful of potash-water every four hours." *Guaiacum* is another remedy which has long had a considerable reputation in chronic rheumatism. It is often administered as follows: Powder of guaiacum, one hundred and twenty grains; iodide of potash, one hundred and twenty grains; tincture of colchicum seeds, three drachms; cinnamon water and syrup to make up six ounces. Label: "A dessert-spoonful thrice daily."



THE TALLERMAN CURE FOR RHEUMATISM.

FIG. 52.—BEFORE TREATMENT.

C. F., Hairdresser. Chronic Rheumatism of two years' standing. Could not raise right arm to chest. Shoulders and elbows very stiff and painful. Great difficulty in walking. Could not stand for more than five minutes at a time, and had only been able to do four months' work in two years.

FIG. 53.—AFTER TREATMENT.

C. F. cured. Can walk miles without feeling any ill effects. After tenth treatment patient was able to put on his boots, and walk for two hours without a stick, a thing he had been unable to do for eighteen months previously.

THE TALLERMAN TREATMENT

Whilst we have just described the treatment of rheumatism, and especially that of the chronic variety, according to recognised medical methods, it now becomes our duty to refer to a mode of procedure of recent invention which in the vast majority of cases cures, and that rapidly, stiffness of the joints resulting from rheumatic attacks. Such cases, due to an attack of acute rheumatism, if neglected, and in some instances even with medical treatment, are apt to result in permanent deformities.

The serious nature of this result can be fully appreciated when we reflect that a large number of persons in this and other countries are debarred from pursuing their daily avocation by reason of useless joints. The amount of poverty and misery in the case of the working-classes which a disease of this kind is apt to entail is very great, and such cases are the despair of physicians who behold them growing worse as time advances. It is therefore necessary in the interests of suffering humanity to refer here to the mode of treatment already alluded to. This is the *Tallerman treatment*, the invention of the late Mr. Lewis Tallerman of London. It has had many imitators, some of the imitations being of a dangerous kind, but the original treatment remains superior to all in respect of its applicability to all cases of deformed joints, and also by reason of the speedy success which attends its use in ordinary cases.

Mr. Tallerman employed *perfectly dry air*, heated to an extreme degree, by way of application to affected joints. It must be noted that the air is dry air. At about 115 degrees Fahr. hot water can hardly be borne. Heat vapour or steam becomes insupportable at about 120 degrees. Hot dry air, on the other hand, can be easily tolerated up to 300 degrees, or even to a higher limit.

In the Tallerman treatment, therefore, a temperature of from 250 degrees to 300 degrees can be borne for almost an indefinite time. Neither pain nor discomfort are experienced by the application of this remedy. The important point of Mr. Tallerman's invention is that in his apparatus the air is duly maintained in the dry state already described.

This apparatus may be shortly described as consisting of a copper cylinder (Fig. 50), made of various sizes and shapes for application to different regions of the body. Into the inner end of this cylinder the limb to be treated is passed, an air-tight curtain encircling the limb at the entrance to the cylinder. At the opposite extremity of the apparatus an opening is provided, from which the moisture escapes at

intervals. Dryness of the air is thus secured, and all risk of scalding or other accidents, such as have occurred with apparatus of another description, is prevented. The heat is supplied by gas-jets, but oil might be used in cases where gas is not available. The gas supplied is regulated according to the degree of heat required, and the apparatus can therefore be used in a private house, as well as in hospitals.

The degree of temperature is shown by means of the thermometer, the bulb of which is placed within the cylinder. Stopcocks also exist in the cylinder, so that an air-pump could be employed for introducing vapours of medicated kinds. The part treated lies on the bottom of the cylinder on a metal support covered with asbestos. This latter layer or substance prevents all danger of scorching. The duration of each application of the Tallerman treatment varies from half-an-hour to one hour, but it may be prolonged beyond this latter period without any discomfort.

The effect of this treatment on cases which under ordinary circumstances would have resulted in the possession of stiff joints and deformed limbs, may really be described as marvellous (Figs. 51, 52, and 53). The Tallerman apparatus is used in a large number of London hospitals, and by those medical men who have taken the time and trouble to investigate its claims, and who have been able to note the state of patients before and after treatment, the Tallerman treatment must come as an extremely welcome and invaluable addition to their means of obviating the serious consequences of rheumatism.

It must also be added that the Tallerman treatment is found to be extremely valuable likewise in cases of *gout*, probably because it very efficiently assists the action of the skin. In the relief of ordinary *muscular rheumatism* its effects are much more quickly produced than by the aid of the ordinary Turkish bath. *Sciatica* and *neuralgia* are also found to be relieved by the Tallerman treatment, and wherever heat is required as an application in diseased states of the body this procedure should be kept in mind.

It should be added that Mr. Tallerman at his own expense instituted in various towns free institutions under the supervision of local medical men, in order that the poor might have the inestimable advantage of cure of their otherwise incurable ailments. The London office of the Tallerman Institute is situated at 50 Welbeck Street, W.

The accompanying photographs exhibiting cases before and after the Tallerman treatment will convey an adequate idea of the rapid and beneficial results of this application to diseases which, under ordinary medical treatment, would have been liable to have developed permanent joint deformities of the kind we have been considering.

GOUT

Gout is often spoken of as a disease of the rich rather than of the poorer classes; but the popular expression, "poor man's gout," indicates a belief on the part of the public that the attacks of this disease are not limited to the wealthy. Probably what is meant by poor man's gout is that variety of rheumatism which has already been referred to as "rheumatic gout," and it is of course perfectly possible that some constitutions might exhibit a combination of the two ailments.

The general characteristics of gout generally considered may be summed up in the statement that it is a disease more frequently affecting the male than the female sex. There is little doubt that a gouty tendency can be transmitted from parent to child, so that the errors in diet or otherwise which serve as exciting causes of the disorder will more readily in such a case act upon an individual in inducing the appearance of the disorder.

Rheumatism was shown to be typically a disease of the poor; gout has been remarked to be more prevalent among well-to-do people. A great physician of former times (Sydenham), who himself suffered from gout, speaks of it as follows: "So lived and so have died great kings, and leaders of armies and fleets, philosophers and men of varied culture, victims to this peculiar disease. It kills more rich men than poor, more wise than simple."

Again, in contradistinction to rheumatism, which we have seen to affect a number of joints of the body at one time, acute gout is as a rule limited to the ball-joint of the great toe. The reason for this curious selection of the seat of attack has been referred to the fact that this joint is more liable to injury and to develop weakness, from the fact that it supports in great part the weight of the body. It is probable, however, that this explanation does not altogether explain the circumstance why gout should make this curious selection in respect of its *locus* in the body. It does not, however, confine its attention to the joint in question, for its symptoms may appear in the heel, ankle, knee, wrist, and thumb. Its later effects may be traced very definitely in the joints of the fingers, which are liable to develop the secretions known as *chalk stones.* Whilst gout may affect internal organs, it does not appear to exert the same malign influence on the heart as does rheumatism.

The word gout is described from the Latin word *gutta,* meaning "a drop." This term was bestowed upon the disease of old on the idea that its cause was represented by some *humour* or liquid that

distilled itself drop by drop into the great toe-joint. As in the case of rheumatism, we find that we have to deal here with a disease the direct result of an accumulation in the body of a substance which otherwise should be excreted from the system. This exciting cause is found in the shape of the acid called *uric acid*. Mineral compounds such as *urates* are also associated with the production of the disease.

The Cause of Gout.—In health we may suppose that uric acid, which is a natural production of the body, passes from the blood in a particular shape or form. It is removed by the kidneys. If from one cause or another the uric acid or its derivatives should accumulate in the blood, gout appears. It would seem as if these substances which should be excreted unite with certain blood minerals, of which carbonate of soda is the chief, and a new compound called *biurate of soda* appears. This latter compound is not at all easy of solution in the blood, and when it is transferred to the kidneys it is found there to be equally difficult of excretion. If this abnormal process continues for a certain time an attack of gout supervenes. When this attack is over and done with, in all probability the individual may recover his normal health, but he has at the same time acquired a certain liability to the return of his enemy. If the attacks should become frequent the disease may spread throughout the body, so that it attacks the fingers, the feet, and may also exhibit effects on the ear, the nose, and other parts.

In this chronic state of gout *biurate of soda* is deposited in the joints and around them so as to constitute chalky concretions, to which allusion has previously been made. These are called in medical language *tophi*. They naturally produce distortion and deformity of the parts in which they occur. It is these deposits which are often spoken of as the "chalk stones" of gout. Along with these local effects we find the kidneys to suffer severely in gout, and a diseased condition of these organs, spoken of as *contracted kidney*, results in considerable disturbance of their functions. The kidney substance may itself show in such a case deposits of the biurate of soda.

Erroneous Living.—Whilst a tendency to the development of gout on the part of the individual body is associated with inheritance of this condition from parents, we must not neglect to take account of another important predisposing cause of this affection, namely, *an erroneous mode of living*. If we assume that the typical condition in this latter respect for the production of gout is represented by an excess of food in the first instance, and especially an excess of rich and highly-seasoned foods, we may thus indicate a very marked

cause of gout attack. This cause is materially strengthened by a condition usually found associated with excessive nutrition of the kind described, alcoholic indulgence. Excess of flesh meat has been usually credited with the production of gout, and vegetarians have rightly or wrongly made a point of insisting upon the recognition of the idea that a spare diet, such as is represented by their creed, is not merely preventive of gout, but may be actually regarded as a curative measure as well. Excess in the matter of rich wines has long been regarded as an important factor in inducing this disease, and it need hardly be remarked that port wine has had laid on its shoulders the chief burden of the blame. All sweet wines in fact tend to the promotion of gout, and malt liquors have not escaped the condemnation of medical men as a cause of the disease. Some authorities incline to the belief that where gout is represented amongst classes of men such as publicans, brewers' draymen, and the like, its presence is due to the fact of their being large consumers of stout or ale. Spirits have not been credited with the same power of gout-production, and the comparative absence of this disease amongst the working-classes of Scotland, who are large consumers of whisky, has been quoted as an instance of the difference of the effects induced by the consumption of one class of alcoholic liquors as compared with the effects produced by another class.

Other Causes.—There can be little doubt that along with excess of food of the character just described we are entitled to rank as another factor in the production of gout *want of legitimate exercise*, and also in all probability *deficient action of the skin.* Another curious fact has been pointed out in connection with this disease, that a certain percentage of patients in the lower classes is drawn from that section which is engaged in the manufacture of white lead. It would thus appear that lead poisoning has some effect in laying the system open to attack. Gout appears to be a disease which is more liable to exhibit attack in the earlier part of the year than at a later season, although of course this rule is by no means an inexorable one.

Symptoms.—The attack is usually ushered in by alterations in the spirits and temper of the individual. Extreme irritability is a marked characteristic of many gouty people, whilst the digestion may be disturbed, and other symptoms of disordered health be apparent. The onset of gout is marked by pain in the big toe-joint. It is described as of a gnawing character, and is of persistent type. It seems to lessen somewhat when swelling of the joint takes place. Associated with this symptom there is a certain amount of fever, whilst the urine is high-coloured and is passed in less quantity than

is natural. Itching of the great toe in some people is regarded as an infallible symptom of the oncoming of an attack. Whilst this disease does not attack the heart in a marked fashion, it may nevertheless affect internal organs. Symptoms produced in this way are always seriously regarded by the physician.

Gout Prevention.—With regard to the prevention of gout, and also by way of indicating the mode of life which should be followed by way of limiting the risk of attack, an important point is necessarily constituted by *the nature of the diet.* The feeding of a gouty subject should be arranged on the side of extreme simplicity, whilst all excess in *quantity* should be rigidly avoided.

If it be true that the production of uric acid is due to the action of our frames on our nitrogenous foods (represented typically by meats of all kinds), it is obvious that any excess in the use of such articles of diet must tend to promote an attack of gout. Whether or not the excess of uric acid be due to excessive use of the foods in question, there are few authorities who do not recognise that an excess of nitrogenous elements, or *albuminoids* as they are also called, have a powerful influence in determining attack.

Food in Gout.—The *general* indication, therefore, for the life of the gouty person is the limitation of his animal food, and the high importance of taking a very considerable amount of vegetable matter in its place. Fat is also regarded as a food not entirely suitable for persons subject to this disease, although the use of a moderate amount of fat is not necessarily to be associated with its production. All kinds of *green vegetables* and *fruits of fresh kind* may be taken by the gouty individual, and if a choice is to be made between meats, those of white nature are regarded as less unsuitable for the gouty individual than red meats. Smoked, dried, or preserved meats, as well as game, should be abolished from the diet-list of the gouty, and rich sauces must be avoided. Cheese and eggs are also foods which should, as far as possible, be omitted from the food. With regard to *fish*, rich and oily fishes, such as the salmon tribe, must also be placed on the list of articles likely to cause attack.

Vegetable Foods.—In the matter of *vegetables* which are regarded from their mineral composition as unsuitable for gouty persons, tomatoes and asparagus have been specially named. Certain authorities, however, allow asparagus deprived of its usual sauce of melted butter. The bread of a gouty person should be toasted. Potatoes are excellent, but any fruits containing a large amount of sugar should be avoided.

Drinks in Gout.—To *milk* no objection can be offered, but it should be used, as a rule, diluted with a mineral water such as Vichy or Kronenquelle.

A very simple but at the same time valuable item in the practice of a gouty person is that of taking a tumblerful of hot water half-an-hour before meals, repeating the dose at bedtime, and if necessary on rising in the morning as well. It has long been pointed out that the use of plenty of pure water of not too hard a description, is an extremely valuable practice in the prevention of this disease. *Malt liquors* should be avoided, and cider also. The wines, excess in the use of which promote gout, have also to be carefully avoided. To the lighter wines, especially if diluted with an alkaline water, no objection can be offered. Gouty persons who are not total abstainers from alcohol may possibly find that a little old whisky well diluted with water, preferably lithia water, or even a little gin occasionally used in the same way, may form a suitable beverage to be taken, of course in moderation. It will be also better for them to eliminate *sugar* as much as possible from their dietary. Where tea or coffee require sweetening the use of saccharin tabloids or saxin tabloids, substances infinitely sweeter than sugar, may be recommended.

It is of importance that the gouty subject should take time over his meals so as to ensure that they are thoroughly masticated. Regularity in the times of taking food should also be strictly observed.

Exercise.—With regard to *exercise*, a certain activity of habit should be regularly kept up. The clothing should also be so regulated as to avoid chill. An occasional hot or Turkish bath will also, by assisting the skin action, tend to produce beneficial results. Those who can afford a residence abroad, and who care to undergo the treatment at certain spas, frequently find that a temporary residence therein tends to their betterment. The waters of Bath, Leamington, Cheltenham, Harrogate, Strathpeffer, and Moffat are used by gouty persons; whilst abroad, such places as Hamburg, Kissingen, Carlsbad, Vichy, Royat, Baden-Baden, and Ems are all celebrated for their treatment of gout by means of the use of waters such as tend, through their absorption by the blood, to absorb or dispel gouty material.

Drug Treatment.—With reference to the *drugs* used by the gouty person, *lithia* has acquired a striking prominence from a belief in its power to cause absorption of the gouty deposits. Five grains of carbonate of lithia to one ounce of water has been employed as a lotion, kept applied to gouty joints where the skin is unbroken. The citrate or carbonate of lithia is generally administered as a drink

to the gouty. Aerated waters containing definite amounts of these substances can be purchased, and can be used as ordinary water for the dilution of spirits or wines. Effervescing preparations of lithia are also commonly sold in the form of granules, which on the addition of water make a pleasant drink.

Of late years a substance termed *piperazine* has been much employed for the purpose of absorbing gouty deposits in the body. It is generally given to the extent of ten or fifteen grains daily, and should be administered in a large quantity of aerated water, this quantity being divided into three doses. *Colchicum* has long had a reputation in the treatment of gout, but of late its use has somewhat been discounted by medical men. This remedy may be given in the form of colchicum wine. The dose is twenty or twenty-five minims every four or six hours, and this amount given in water will be sufficient. It is to be noted, however, that colchicum does not suit every case of gout, and it is the opinion of some authorities that its use lays the patient open more readily to subsequent attacks.

Attention to the state of the bowels is highly necessary in this disease, and a favourite prescription combines colchicum with magnesia. This may be given in the form of a draught as follows: Wine of colchicum, half a drachm; carbonate of magnesia, fifteen grains; sulphate of magnesia, one drachm; cinnamon water to make up two ounces. These quantities form one dose.

Local Treatment.—The *local treatment* of gout consists in protecting the inflamed toe. This should be enveloped in cotton-wool. In some cases a poultice is applied, a little tincture of opium (or laudanum) being sprinkled upon it. Warm fomentations may also be used to the affected parts, and to the hot water a little tincture of opium or belladonna may be added.

Chronic Gout.—In the *chronic variety* of gout the use of lithia as above indicated will be found to be of benefit, whilst colchicum taken in a dose of four or five minims of the wine twice or thrice daily for a time may be found useful. If the chalk deposits should become very prominent and painful, it may be the duty of the surgeon to remove them. The difficulty presented by this practice is that any sore or wound in a person the subject of chronic gout does not as a rule exhibit a tendency towards ready healing. It may be mentioned that the idea of applying leeches to inflamed joints in gout should never be entertained.

HYPERTROPHY AND ATROPHY

A few additional illustrations of general diseased states may be appropriately introduced at this stage of our inquiries.

In the case of constitutional disease, the physician has frequently to deal in his practice with two conditions, named *hypertrophy* and *atrophy* respectively.

As mention of these terms is included in a work of this kind, it is necessary to explain here their exact signification. By *hypertrophy* of any part is meant its overgrowth; by *atrophy* we mean to imply the converse condition—that of wasting.

An excellent example of *hypertrophy* is found in the case of certain conditions represented in connection with heart troubles. As the result of some obstruction to the easy working of the heart, that organ exerts additional force by way of overcoming its difficulty. The result is that the particular part of the heart involved tends to develop a greater thickness than is natural to it. The muscular fibres grow thicker and larger, and the heart in such a case would be said to exhibit the condition of hypertrophy. In the same way we may find that all blood-vessels grow thicker when some obstruction results to the easy flow of the blood along them.

Atrophy.—In the case of *atrophy* we may find an illustration of this condition naturally represented in the body in the case of advancing age. Thus bone, by losing so much of its animal constituents, undergoes a process of atrophy. In the same way, where the muscles are not properly used they tend to decrease in size, and an example of this condition is found where, in consequence of paralysis, the muscular tissue becomes more or less diminished. These conditions, it will be seen, represent the result of diseased actions, but they become of extreme importance in connection with the symptoms they produce from the alteration of the bodily work they naturally perform.

Anæmia or "*bloodlessness*" and other conditions connected with faulty states of the blood will be treated under the *diseases of the Heart and Blood-vessels.*

DIABETES

Diabetes may be regarded as a disease very properly ranked under the head of general ailments of the system. This for the reason that although the condition represented in this disorder

introduces us to some definite form of ailment, its effects are widespread in character as regards the body, and in respect of this cause we have to look considerably further afield than would be included under a mere view of the organs concerned in the disease-processes.

It may be mentioned that there are two distinct disorders included under the term diabetes. One of these may be dismissed in a few words. It is termed *diabetes insipidus*, another name for this affection being *polyuria*. This disease is of comparatively rare occurrence. It appears to affect males chiefly, and may occur at any period between the ages of five and thirty years. After the latter period it is comparatively rarely met with.

The characteristic feature of this form of diabetes is the passage of a *very excessive amount of urine*. This fluid is of pale colour and clear. On being tested it is not found to contain sugar or albumen. These two substances at once attract the attention of the physician in the case of other disorders in which the kidneys are involved. Incidentally we find the subject of this disease to exhibit a dry skin and a thirst that is practically insatiable. The urine may amount to twenty pints in the twenty-four hours. There is in addition digestive disturbance, whilst a certain amount of debility is present, and general weakness of the muscles is also noted. It is believed that this disease, as regards its cause, has a distinctly nervous origin. One interesting feature connected with it is the fact that in hysterical women, after an attack, a large flow of urine is apt to occur. The disease is of uncertain character as regards its result, but it is not regarded as being essentially or immediately dangerous, although it most undoubtedly tends to undermine the general health.

Treatment.—The treatment of this disease is of a somewhat indefinite character. The *liquid extract of ergot* has been employed by physicians, whilst opium has also formed the sheet anchor of treatment. A large number of other drugs have been experimentally tried without marked success. These have included iron, quinine, iodide of potash, and valerian.

True Diabetes.—True diabetes is scientifically known as *diabetes mellitus*, this latter term indicating one of the chief features of the ailment, namely, that sugar is passed with the urine, which last fluid is found to be excreted in increased quantity. This ailment has long been known to physicians, although its exact nature was not clearly apprehended for many years.

Diabetes and Food.—In order to understand the nature of diabetes it is necessary to glance first of all at certain important facts connected with the food, and especially those articles of diet which

are included under the head of *carbohydrates.* These foods are represented by the starches and sugars we consume. Such articles as bread, potatoes, rice, tapioca, and the like contain quantities of starch, whilst of course sugar itself is taken as sugar and in other forms. It may be said that the fate of all starch in the body is that it is ultimately changed by the digestive processes into a sugar. The explanation of this fact is probably found in the circumstance that, whilst sugar is extremely soluble, and can mingle with the blood or other fluids, besides being readily absorbed, starch does not exhibit these qualities. Sugar and starch are so alike, chemically speaking, that the transformation from the one into the other is easily effected.

The starches we take as food and the sugars themselves are ultimately taken up from the digestive system and find their way into the liver through the large *portal vein* which enters that organ. Arrived in the liver, the sugar is converted by the liver cells into a substance called *glycogen* or *animal starch*, and in this form it appears to be stored up in the liver.

Bernard's Discovery.—About the year 1848 Bernard, the famous French physiologist, pointed out that this stored-up starch was re-converted by the liver into sugar and passed out from the liver into the general circulation of the blood by the *hepatic vein.* Bernard further assumed that the destination of this sugar was the lungs. He held that, being chemically burned or oxidised in the lungs, it afforded a supply of bodily heat. He supposed that, in the case of diabetes, the liver's output of sugar being excessive, the body could not utilise the amount, hence this sugar, being thrown into the blood in too great amount, was carried to the kidneys, and by them excreted from the body, giving us in this way a prominent symptom of diabetes, namely, urine loaded with sugar. This view of the origin of diabetes has been very generally accepted. We may assume that the liver is at fault, in that it practically gluts the bodily market with sugar.

Another aspect of this question is that which assumes that the liver itself may not be producing an excess of sugar, but may be supplying the body with a normal amount of this substance. Only if some condition of body exists whereby the tissues are unable to utilise their ordinary amount of sugar-diet, diabetes might be thus referred as regards its origin to such a deficient condition on the part of the body's tissues themselves.

An opposing view to this theory of the origin of diabetes has been propounded. It is held that sugar is not sent out by the liver, but is practically used up or consumed in that organ. If the liver fails

in its duty of disposing of the sugar, diabetes is then produced; the cause of the disease in this view being credited to the share of the liver itself. As, however, it has been fairly well proved that blood leaving the liver contains a higher proportion of sugar than the ordinary blood of the body, this latter view has not been received with universal acceptance by physicians.

It may be added that in the healthy body the destination of the sugar paid out by the liver is believed to be, not the lungs, as Bernard supposed, but the muscles of the body. To the muscles the sugar will represent a definite form of energy-producing food, and incidentally we know that it is in the muscles that the heat of the body is produced. Sugar in this way is not merely a force-producing food, but likewise a heat-producing one.

It is now recognised that there are two distinct forms of true diabetes, one in which the liver, as we have seen, is definitely concerned, and another which includes some interference with the work of the *pancreas* or *sweetbread*. By far the more serious causes of the disorder are those of the latter nature. A much larger quantity of sugar is passed in the urine than in the case of diabetes arising from disturbance of the functions of the liver.

It may be assumed, however, that in almost all cases of diabetes the sweetbread plays a certain part in the production of the ailment. It is believed that the sweetbread has the duty of not merely aiding in the digestion of the food, but of supplying to the blood a certain secretion which aids in disposing of sugar present in that fluid. Where, on account of any condition affecting the sweetbread, the amount of sugar in the blood is thus allowed to increase, we can readily understand how what has been called *pancreatic diabetes* originates.

Its Causes.—A curious fact was noted by Bernard that when a particular part of the rabbit's spinal cord was punctured, this part lying at the base of the brain, sugar appeared in the urine of the animal. This fact introduces us to the question of the exact cause of this disease. It may be said that the causation of diabetes is still a matter of doubt and uncertainty. We are able to understand something of the nature of the disease, as we have seen, but the more intimate cause or condition leading to derangement of the liver or sweetbread is still hidden from us. Bernard's experiment on the rabbit has suggested that this disease may have its origin in a derangement of some particular nerve centre or other which has been credited with the function of regulating the supply of sugar to the body. The diabetic condition is also known to occur after mental disturbance and great worry, and an interesting observation has been

made in the shape of the statement that an examination of engine-drivers who conduct fast or express trains show that they suffer very largely indeed from diabetes. The nerve strain to which these men are exposed in the exercise of their work is believed to account for the high prevalence of this ailment amongst them. A temporary condition similar to diabetes may be produced when a great excess of sweet foods are taken. It is also known to be associated with tumours of that part of the brain already alluded to in connection with the experiment in the rabbit. Males are much more subject to diabetes than females, whilst it is said to be a disease specially characteristic of the Jewish race. It is also important to note that as far as age is concerned, the most serious cases are those which occur in comparatively young persons.

Symptoms.—With regard to the *symptoms* of this trouble, it has been noted that the urine is not merely largely increased in amount, but contains a large quantity of sugar. The urine is of pale colour and gives off a sweetish odour, which has been compared to that of a chamber in which apples have been stored. No sediment is deposited from the urine, and when its specific gravity is tested, it is found to be of a high character.

Under the head of *kidney diseases* the testing of the urine for sugar and other substances will be specifically alluded to. Other symptoms of diabetes are found in the presence of great thirst, whilst the appetite is usually voracious in character. These remarks have led to a popular classification of diabetes into "eating diabetes" and "drinking diabetes." This classification is founded on a misconception, for there is but one disease of this kind, and in that disease the appetite both for food and drink is markedly increased.

Along with these symptoms we find the patient growing weaker, on account possibly of degeneration of the muscles produced by the disease. In addition to these complications of the disease may be also mentioned the occurrence of itching, which is extremely liable to make its appearance in the generative organs of women. The eye also shows certain changes, one of them being the production of cataract, whilst inflammation leading to gangrene is not an uncommon complication. The skin is dry and sallow, whilst the body grows thinner and becomes more or less emaciated. Pain is complained of chiefly in the muscles of the calf of the leg, whilst the muscles that extend the feet are also liable to be affected. The *temperature*, as a rule, is lower than normal. Constipation exists, and it is notable that the sexual powers of the individual tend utterly to fail.

Course and Complications.—Diabetes is a disease which runs a slow and steady course, unless the treatment has been begun early in

the course of the disease and proves to be successful. The complications of this disease are seen in a liability to be attacked by lung affections, whilst it is no uncommon thing to find dropsy of the lungs and the formation of carbuncles on various parts of the body. Death results in diabetes practically from blood-poisoning, this inducing the condition known as *coma*, in which the patient passes away practically in an insensible state without exhibiting any convulsions.

Treatment.—The treatment of this disease, it will be understood, must largely consist of *due regulation of the diet.* It is obvious that if there is excess of a particular food material in the blood or body, that excess must be attacked by checking the income from this particular source. Physicians are accustomed to rely largely on their observation of the success of dieting a patient, in gauging the probable seriousness of the case or the reverse. Consistently with the limitation or disappearance of the amount of sugar passed in the urine, the patient's chances of recovery may be estimated. In former years it was the custom in prescribing a diet for this disease to eliminate from this food all starchy matters as far as possible, and, of course, sugars as well. To-day it is recognised that a certain amount of these foods may be allowed, for the reason that they are required for the support of the body in the first instance, and it is found that limitation of their amount brings about all the good results which were formerly supposed to accrue from their complete exclusion from the diet. But the main principle still holds good, that having regard to the patient's nutrition, starchy and sugary substances must be relegated very much to the background of his diet.

A Diet List.—In making up a diet list for diabetic persons we find the following foods may be allowed. He may take butcher's meat, poultry, and game. Fish is also permitted to him ; cheese, eggs, butter, and fat generally are also allowed, although an excess of fat must be avoided. If broths or soups are taken no meal or rice must be contained in them. All sugary matter must be avoided, and therefore jellies containing such substances must be tabooed. Diabetic persons are recommended to use various kinds of sweetening substances which do not contain sugar, and which are far sweeter indeed than that substance, such as tabloids of *saxin* and *saccharin*, to sweeten any fluids or substances as may be desired. With regard to *vegetables*, the rule is that green vegetables at large may be safely taken. Cabbage, broccoli, lettuces, endive, spinach, young or spring onions, watercress, and celery are all permitted. Cauliflower is generally, however, omitted from the list.

Diabetic Drinks.—With regard to the *drinks* of the diabetic person he may take dry sherry, claret, brandy, and whisky ; and light

beer is not absolutely forbidden : but his tea and coffee must have no sugar, whilst an alkaline water, such as soda-water, is allowed. The bread eaten by diabetics is generally of a character known as *gluten bread.* There are various varieties of such bread specially made for diabetics, but care should be taken to see that they do not contain any great amount of starch. Toasted bread would be much less injurious than ordinary bread.

Forbidden Foods.—Turning now to the list of forbidden foods and drinks we find shortly that ordinary bread, potatoes, rice, tapioca, turnips, carrots, parsnips, peas, and beans must all be avoided. Oysters and other shell-fish are forbidden, probably because they contain a large amount of liver substance which will tend to the formation of sugar. All fruits of sweet character are forbidden. With reference to *drinks*, sweet wines are of course not permissible. One plan of treating diabetics by sole reference to the diet is that of administering nothing but skimmed milk in large quantities. With reference to this mode of treatment, however, it may be added its disadvantage is that the patient soon sickens of its monotony; and, second, that this mode of treatment is not regarded as remarkably successful, although certain cases of the disease occurring in stout persons appear to have benefited from the practice in question.

Drugs.—The *drugs* used in the treatment of diabetes have been many. Without a definite knowledge of the cause of the disease, all treatment of this kind must be regarded as more or less of an experimental or empirical order. Some physicians have relied on a preparation of opium, known as *codeine.* The dose is half a grain given thrice a day, this amount being increased later on to the extent of three grains. Antipyrin has also been given in a dose of ten grains thrice daily, and has occasionally been found to reduce the quantity of the sugar. The tonic treatment of this disease has been carried out by the administration of arsenic, strychnine, and the like tonics.

To relieve the extreme thirst, give citrate of potassium in large doses diluted with water. This may best be given either before a meal, or from half-an-hour to three-quarters of an hour afterwards. It is of great importance to note that the action of the bowels should be rigidly attended to, and constipation avoided, if need be, by the use of an occasional saline purge.

Some physicians in order to relieve the thirst are in the habit of prescribing one twentieth part of a grain of *pilocarpine*, which, placed on the tongue thrice daily, appears to have a certain effect in relieving the thirst. Vichy, Carlsbad, Contrexeville, and Vals, are the chief resorts to which diabetics are sent for a course of waters.

SECTION IV

FEVERS AND OTHER INFECTIOUS DISEASES

FEVER IN GENERAL

Before proceeding to a detailed consideration of those ailments known as "Fevers," each of which diseases may be regarded as being due to a specific cause in the shape of its germ, it is necessary that we should glance at the subject of *fevers at large*, dealing in this way with the feverish state as a general disease symptom. This state exists as a sign of many diseases other than those specifically known as "fevers." Its chief characteristic, and that which has been most popularly appreciated, is a *rise of the bodily temperature.* This subject has already been referred to in a previous section of this work under the head of *temperature* itself. It was there shown how, by the aid of a clinical thermometer, we could determine with great accuracy the amount of temperature-rise represented in any given case. The old physicians, destitute of this latter means of estimating temperature, recognised at least that the heat of the body was markedly increased in feverish states. They were led to this conclusion largely by the state of the skin.

In the healthy subject the skin is somewhat moist, and, as compared with the heat of the hand, is fairly cool, whereas in fever the skin becomes dry, and on feeling it a sensation of additional warmth is conveyed to the hand.

Temperature in Fever.—It has already been noted that whilst the natural temperature of the human body ranges from 98.4 to 99 degrees (Fahr.), a slight degree of fever would send the thermometer up to 101 degrees in the morning, with a slight increase of this latter amount in the evening. An ordinary fever-attack would show from 101 to 103 degrees as the morning temperature, rising to 105 at night. All temperatures above 105, as has already been remarked, are to be considered dangerous. Fever has thus always been recognised as a state of body of which an increase of temperature above what is natural to the body is the chief symptom.

A definition of this kind, however, does not in any sense explain

the cause of the symptoms in question. We have to look much more deeply into the nature of fever in order to ascertain, if possible, the meaning, not merely of the increase of temperature, but also of other symptoms and signs which accompany this state.

Heat and Fever.—The heat of the body, it may be here briefly remarked, is dependent on the food we consume. If we compare such food to fuel, its chemical combustion may be regarded as supplying us with heat. This combustion takes place in the tissues, and the muscles may be regarded as the chief seat of this operation. The waste resulting from this action, composed of carbonic acid, water, and other substances—the ashes of the bodily fire—given off to the blood as bodily waste, are excreted from the body by the lungs, skin, and kidneys. So far, the production of natural heat may be readily enough explained.

Another important point in connection with the understanding of heat increase in fever is that which refers to the regulation of our bodily temperature. It is obvious that where some disturbance of the heat-producing functions occur, the due and natural regulation of heat-production must be seriously interfered with. Hence we discover that the chief source of the regulation of heat is to be found in the action of the skin, which not merely presents a large surface for heat-radiation, but likewise provides for the maintenance of the blood at a certain temperature through the action of the sweat or perspiration which is perpetually being evaporated from the skin-surface. There is also an intimate connection between the regulation of heat and the work of the lungs, seeing that these organs discharge functions which in many respects resemble those performed by the skin. It is also known that the bowels may exercise a certain influence on heat-regulation, and we obtain an excellent illustration of this latter fact when it is found that by the use of a saline, or other purge, producing free movement of the bowels, the fever-state tends to be reduced.

Heat Regulation.—To go a step further backwards in the history of heat-production and heat-regulation, it may be noted that these actions are controlled by certain centres of the nervous system set apart for their governance. It is highly probable that these centres are situated not merely in the brain, but also in that portion of the organ represented by the junction of the spinal cord and the brain. This particular region is known as the *medulla oblongata.* Physiologists are also inclined to believe that the brain exercises yet another important duty in connection with the regulation of heat. This latter function represents that which maintains a kind of balance or equilibrium between the production of heat and the loss of heat in the body. We might term this arrangement a compensatory one, seeing it is highly probable that in the healthy body it serves to check an undue

increase of heat on the one hand, and on the other hand to stimulate heat-production where the latter action is necessary.

The Germ Theory and Fever.—Now, in the case of "fever," all these functions must undergo a greater or less amount of disturbance. Especially must this be the case in the compensatory duties of the brain, to which allusion has just been made. Before the advent of the germ theory, and before its application to modern medicine, the exact nature of the substance, principle, or poison to which fever owed its origin was unknown. Many theories and suppositions were advanced to explain this point, but nothing definite was known of the exact cause of fever itself, or of the reasons why one fever differed materially in its symptoms and course from another, until the *germ theory* came to the rescue of the physician. This theory (to be fully dealt with under the head of *Bacteriology*) is that which holds that not merely fevers but other diseases owe their origin to a specific cause, namely, the attack on the body by special *germs* or *microbes*. In the modern view of matters, therefore, the germ of each element breeding and multiplying within the body, and producing thereby a poisonous principle or *toxin*, may be regarded as the direct cause of a fever or other element traceable to germ infection. This toxin carried by the blood to the nerve centres may be regarded as the probable cause, not merely of the disturbance of the heat regulations already alluded to, but also of the production of the special symptoms to be noted as proper to each ailment of the class we are considering.

Fevers and Life.—It may be interesting here to remark the likeness which a fever presents in its course, development, and decline to the growth and life history of an animal or plant. This similarity need not surprise us when we reflect that the "germ" or "microbe" to which the fever owes its origin is itself a living particle, probably representing a very low form of plant life, and, in some cases, of animal life. The fever begins with the literal sowing of the seed, a process which, in common language, is termed *infection*. The germs are breathed in, or swallowed, or otherwise gain admittance to the body. Then follows a period of quiescence or apparent rest, during which the germs are breeding and multiplying in the body. This latter period is known as that of *incubation*—that is to say, a time devoted literally to the hatching and development of the germs. Then succeeds the growth of the fever marked by the appearance of all its *active symptoms*. This period continues until the ailment may be said to come to a head, when it reaches the acme and head of its development. Finally *its force declines*. It appears to be on the down-grade track. The symptoms lessen, and the fever itself dis-

appears, leaving the body it may be much weakened, but only requiring care to be restored to its normal healthy state. This course of development corresponds, as may readily be seen, to the life history of every animal and of every plant. For like the fever, the living being passes through a period of infancy and youth, attains its highest development as an adult, and then gradually declines towards the period of old age and death.

There are other likenesses to be detected between fevers and the living thing. For example, each fever, like an animal or plant, appears to demand its own and special condition for growth. *Yellow fever* cannot flourish in temperate or cold climates. Its germ demands tropical heat for its full development. The germ of typhus fever requires as its soil the foul air of overcrowded places, and breeds and multiplies amongst the refuse given out from human lungs, this condition being associated with the presence of dirt and starvation. The germ of typhoid fever, on the other hand, finds its own special soil in decomposing sewage-matters, and it is probable that the microbe of diphtheria selects much the same surroundings.

A second likeness to the animal and the plant on the part of disease-producing microbes may be found in the fact that, as a rule, they breed true. If we sow the germs of small-pox in a human body small-pox alone is developed. Diphtheria germs produce that disease and no other, and the same holds good of all other infectious troubles. As the animal and plant each produce their like, so a fever in its turn breeds a like disease. Cases in which, apparently, symptoms of a mixed character have appeared, in the case of fever are probably explained on the ground that there has taken place a *double infection*, where such an event may be considered possible. It is well within probability that the influence of the one set of germs may modify that of the other, and thus apparently produce a hybrid or half-and-half disease, the symptoms of each being by no means so typically represented as where infection has been of single and direct character.

Other Infectious Diseases.—It may be here noted that what we have termed the "infectious fevers" are not the only diseases by any means whose symptoms are due to the invasion by the body of specific germs. Such a disease as *tuberculosis* is known to be caused by the infection of the body, and specially of the lungs, by a special microbe. Hence this ailment falls to be regarded as, in the truest sense of the word, an infectious trouble. *Tetanus* (or "*lock-jaw*") is also to be classed under the head of an infectious disease equally with hydrophobia. In the case of *tetanus* we know certainly that infection of the wound must take place by its germ. The microbe lives everywhere in the earth and among stable refuse. Although the germ of

hydrophobia has not yet been discovered, there can be little doubt that this ailment also results from direct infection produced by the bite of a rabid dog. Syphilis is another disorder undoubtedly caused by infection of the body with a special form of germ, and we might add to this list such a fever as splenic fever or anthrax. That disease of the horse known as *glanders*, which exercises a singularly fatal effect on man, is also the result of microbic infection.

Such an ailment as *leprosy* is known to be caused by the reception of a special germ, and there is at least one form of *pneumonia* or *inflammation of the lungs* associated, apparently as its cause, with a particular microbe.

In all of these diseases we find certain of the symptoms already pointed out as common to all fevers produced. In the case of tuberculosis or consumption, for example, there is noted a rise of temperature, thus showing disturbance of the heat regulation of the body as a distinct symptom of the ailment.

Fever Development.—At a later stage of this work the subject of modes of infection will be considered at length. In the case of each fever the special mode of infection will be duly alluded to; but a reference may be made here to the fact that infectious diseases, and particularly those known as the *true fevers*, appear to be regulated, as regards their periods of highest development, by sundry external conditions. In a previous section reference has been made to the influence of *climate* as modifying the onset of such diseases in one direction or the other, whilst it was also shown that the particular season of the year has much to do with chances of attack from these infectious disorders. It is probably due to the fact, of the dependence of the microbes upon external conditions to a greater or less extent, that many of these diseases appear to be more or less persistently present in certain localities. Where this fact is noted of any disease it is said to be *endemic*. An illustration of this fact is found in the case of *cholera*, which is *endemic*, or more or less constantly present in certain parts of India, and particularly in the Delta of the Ganges. Leprosy is still *endemic* in some parts of Norway and in certain South Sea Islands.

Epidemics.—In Britain there is reason to believe that certain districts or areas show endemic centres for diphtheria, scarlet fever, and typhoid fever. Where from such centres, from one cause or another, a fever or other disorder of the kind under consideration spreads over a wider area, its germs being carried by one medium or another, and where large numbers of cases appear to be developed, the ailment is then said to be *epidemic* in character.

We are only too familiar with such outbreaks of small-pox, scarlet

fever, measles, and of other ailments; whilst although cholera has happily been practically banished from our midst through attention to sanitary details, waves of it occasionally spread from east to west involving Europe in their course. If a disease acquires an almost universal distribution over the surface of the globe it is termed *pandemic* in its character. A curious point with reference to this lighting up of disease is noted in the case of certain ailments. Thus sanitarians recognise that scarlet fever in temperate areas appears to show a tendency to epidemic outbreaks every five years. Epidemics of measles occur more frequently, their period being that of two years' interval, and the same remark applies to whooping-cough.

Attacks on Lower Life.—Man, it may be said, shares his liability to the attack of certain of the diseases in question with certain allied animals. Thus *vaccinia*, represented by the *pustules* which appear in the cow or calf, and whose matter protects when it is used to vaccinate man against small-pox, may be regarded as a disease common to man and the cow. Under this idea we might say that "cow-pox," or *vaccinia*, affects both the bovine and the human species. *Tuberculosis* attacks not merely cattle, but also occurs in certain birds, the common fowl and the parrot representing such species. Rabies in the dog, as we have seen, causes hydrophobia in man. *Lock-jaw* is common in certain lower animals, and the cat is an animal which not merely can infect man with *diphtheria*, but may in turn be infected from him.

Epidemic Variations.—There is exhibited a wide variation in the severity of attack of these diseases. This variation does not merely apply to the cases of the individual, but is also exemplified by the influence of the disease as exhibited in the case of large numbers of persons, or, in other words, in its epidemic form. Some epidemics are of very mild character, others, on the contrary, are of severe character, in which latter case the mortality is certain to rise. The character of an epidemic is generally regarded as being most clearly marked in its earlier development than when it tends to die out. It is curious likewise to note that in the case of scarlet fever and small-pox the mortality on the whole is greater in males than in females.

Protection and First Attack.—Yet another important general consideration with regard to the infectious fevers as well as to other ailments is the fact that in many cases *one attack protects against a second.* It should be noted that exceptions to this rule are frequent, a fact explicable on the ground that the body of no two persons present precisely the same relationship to the disease. In the case of *small-pox* attack the protection is usually complete. The same rule usually holds good of *scarlet fever* and of *measles*, although secon-

dary attacks, as already noted, are not uncommon. Of *typhoid fever* it can hardly be said that one attack offers protection against a second, whilst of diphtheria this remark also holds good. In such cases what we may suppose happens is that for a time after an attack a form of bodily protection is developed. This protection, however, to whatever cause due, sooner or later wears out in the case of some disease, leaving the subject exposed to the risk of subsequent infection.

Theories of Immunity.—If science is appealed to in order to explain the manner in which the protective influence of one attack of disease against another is brought about, we find three views to have been enunciated. One of these theories maintains that as the result of the first attack the development of the germs in the body leaves behind it some principle (or, as it may be called, an *antitoxin*), which serves to prevent the microbes of a second infection from successfully invading the body. A second theory assumes that the germs of the first attack exhaust the soil represented by the body and its tissues, and take from it some substance or other necessary for the growth of the microbes. In this way the soil is barren as regards a second infection. A third view is that of personal protection of the body by means of the white cells of the blood. Full reference has already been made to this action on the part of the white blood corpuscles when dealing with the subject of inflammation. There can be little doubt that this last is a process typically represented in the life history of animals.

Whatever view may be taken of the cause to which protection from a first or subsequent attack of disease is due it may be possible that each explanation just given may contain a certain amount of truth, and that the defence of the body may in this way be attained, not by one method or means alone, but by the combination of all three.

A Great Health Lesson.—It is of the highest importance, not merely from a personal but from a public health standpoint, that we should have impressed on our mind the great truth that *each case of infectious disease is the child and offspring of a preceding case.* In other words, an infectious disease can no more arise *de novo* than we can account for the growth of a potato in a field by assuming that the plant was produced through some combination or other of the elements of the earth and without the presence of a parent plant. This idea, in fact, underlies the whole teaching of the germ theory, and may be said to constitute its firm foundation. Each microbe is derived from a parent germ, and in its turn is capable of giving rise to other germs like unto itself.

Applying this great and leading principle to the causation of infectious disorders, we learn the lesson *that each case of fever or*

other ailment of this kind must have had its origin in a preceding case or cases. It is only possible for typhoid fever, for example, to be caused by our swallowing its germs, and these germs can only have reached us from a preceding cause of the disorder. If a tramp suffering from typhus fever or small-pox marks his track through the country by infecting all with whom he chances to sojourn, we see similarly that each case thus produced (liable in its turn to give rise to other cases) illustrates the same law—that each infection is the undoubted offspring of a preceding infection.

Disease Prevention.—We here note the possibility of *disease prevention* by careful attention to the *early separation and isolation of first cases of disease.* It is not too much to say for example that if in every case of typhoid fever efficient disinfection of the bowel-discharges was performed, so that no germs were allowed to escape from the patients' bodies to pollute a water-supply (or the air possibly), we should markedly limit the spread of this disease. What has been done in the case of cholera should be capable of being represented in the prevention of other infectious disorders.

Sporadic Cases.—Epidemics frequently have their origin in what are called *sporadic* cases—that is to say, single cases appear apparently without any definite cause or source of infection. Such instances simply represent the lighting up into activity of disease-material which, as we have seen, is liable to be present in a locality. It is these cases which require to be laid hold of and separated when discovered. Such action would in this way prevent the one case multiplying itself into thousands.

There might be very considerable difficulty in effecting the instant isolation and treatment of fever cases, but if the public were only instructed in the tremendous power they possess through the early recognition of infectious disorders and the separation of those affected from those who are well, the death-rate from all fevers would be considerably reduced. The lesson cannot be too often repeated, that whilst we are not always able to trace the exact source of infection, we may consider it to represent a law, without exception, that every case of infectious disorder must have had its origin in a parent case.

THE GENERAL TREATMENT OF FEVER

Only a few words are permissible in dealing with this subject, seeing that the special points involved in the case of persons suffering from the diseases in question will be considered in the case of each special disorder.

Having regard to the fact that an *increase of heat* is one of the leading symptoms of fever, it was very early in the history of medicine regarded as a salient point in the treatment to attempt to reduce the temperature. This treatment of old was represented by *bleeding*, and as has been remarked in the section of this work devoted to the treatment of inflammation, the practice of removing blood from a vein has been given up chiefly because of the better understanding of the cause to which the increase of temperature is due. Seeing that this cause is represented by poisonous principles the results of germ growth, which practically affect the frame at large, it must be regarded as an impossibility to improve the *quality* of blood by any action which has for its aim a reduction of this *quantity*.

Physicians, nevertheless, are accustomed to employ various means for reducing the temperature, especially in cases where it may appear to be present in an excessive degree. Reference was made in the section dealing with inflammation to the use of *aconite* in reducing temperature. This drug, used after the manner already indicated, is found to be extremely useful for the reduction of the bodily heat. Medicines which act in this way by reducing the temperature are called *antipyretics*. Certain of these are fairly well known to the public themselves. Thus *antipyrin*, *phenacetin*, and *caffein* are in common use at the hands of physicians. Occasionally caffein is joined with phenacetin; the dose of each agent (or of the two combined) is ten grains for an adult. This dose may be repeated in from three to four hours as occasion requires. Where a mixture *adapted to promote skin action*, and in this way to reduce fever, is required, the following may suffice: Liquor of the acetate of ammonia, half an ounce; spirits of nitrous æther, three drachms; tincture of hyoscyamus, three drachms; camphor water to make up six ounces. To be labelled: "A teaspoonful to be given every two hours." Quinine itself is frequently used for the same purpose. A dose of twenty grains of sulphate of quinine administered in milk is frequently used in the treatment of typhoid fever by way of reducing the temperature, the dose being given twice or thrice in twenty-four hours according to the state of the temperature. Salicin, alluded to in connection with the treatment of rheumatic fever, also acts as an antipyretic. The dose here varies from twenty-five to thirty grains, given in milk every two hours until the temperature begins to fall.

Other means of reducing the temperature is that represented by the use of *cold sponging*, or by the immersion of the patient in a *cold bath*, or by the use of the *cold pack*. These measures, however, require great care in their application, and should on no account be brought into requisition save under the direction of a physician.

Fever Table No. I.

Table showing (1) the period of incubation of the disease, and (2) the period during which infection is liable to occur from it.

The *period of incubation* is that between the time of infection and the first appearance of the active symptoms or signs of the disease.

The *period of infectivity* represents that during which the patient is liable to infect others and during which he should not be permitted to mix with healthy persons.

	Period of Incubation.	Period of Infectivity.
Cholera	One to five days.	Three weeks.
Typhoid or Enteric Fever	Eight to fourteen days.	Six weeks.
Diarrhœa	One to four days.	One to two weeks.
Diphtheria	One to eight days.	Six weeks (probably longer).
Measles	Ten to fourteen days.	Four weeks.
German Measles	Six to fourteen days.	Three weeks.
Chicken-pox	Ten to fourteen days.	Three weeks.
Influenza	One to four days.	Three weeks.
Mumps	Fourteen to twenty-two days.	Three weeks.
Scarlet Fever	One to six days.	Six to eight weeks.
Typhus	One to fourteen days.	Four weeks.
Whooping-cough	Four to fourteen days.	Eight weeks.
Small-pox	Twelve to fourteen days.	Six weeks.
Erysipelas	One to five days.	One week or slightly longer.
Tuberculosis	Indefinite.	All through the treatment.
Relapsing Fever	Five to seven days.	Four to six weeks (owing to relapses).

Fever Table No. II.

	Appearance of Eruptions in Fevers and their situation in	Eruption begins to fade on
Measles	Fourth day of fever, on the forehead.	Seventh day of fever.
Chicken-pox	First day of fever, on shoulders.	Fourth day the pustles scab over.
German Measles	First to fourth day, on the face.	From third to sixth day of fever.
Small-pox	Third day of fever, on face and forehead.	Probably scab on ninth or tenth day of fever, dropping off about the fourteenth day.
Scarlet Fever	Second day of fever, on the body.	Fifth day of fever.
Typhoid	Seventh or eighth day of fever, on the belly.	Twenty-first to thirtieth day of fever, after succession of crops of spots.
Typhus	Fifth day of fever, on sides and back.	Fourteenth day of fever.

SIMPLE FEVER

Under this name is included a feverish disease of simple nature by no means dangerous and apparently of non-infectious kind. By many physicians this condition is regarded rather as a mere symptom of some bodily derangement than as constituting an actual ailment in itself. Its medical name is *febricula*, a term which in itself indicates the nature of the ailment as ordinarily represented. The *causes* of simple fever are frequently referred to digestive disturbances, whilst undue fatigue or exposure to extreme heat or cold may induce its symptoms. These present very much the same routine we are accustomed to note in the attack of more serious troubles. There is headache, weariness, indisposition to work, and a loss of appetite. *Muscular pains* may be described as present, whilst the patient often complains of a feeling of giddiness, which proceeds along the course of the spine, and may be followed by shivering. These symptoms, it should be noted, are not at all unlike those which precede an attack of *influenza*, but in a case of simple fever there are wanting the more serious disturbances of the system which we have come to associate with the presence of the last-named ailment.

We may possibly regard a case of simple fever as depending on some condition or other affecting the heat control of the body, but proceeding as it were no further on the high-road to disease production. There is undoubtedly in this ailment a rise of temperature. The pulse also is generally full, bounding, and greatly increased in the number of its beats. The urine may be high-coloured and its secretion much diminished. The disease as a rule runs a simple course, and terminates by the gradual cessation of the fever and by a lowering of the pulse and temperature, recovery being marked by profuse perspiration. After such an attack a certain period elapses before the patient gains his normal strength.

The Diagnosis.—The physician's difficulty in connection with this disease is that of determining whether or not it represents the prelude to a more serious trouble, or whether in itself it constitutes the simple attack indicated by its name. His procedure here is that of noting what may be called the negative side of the ailment. For example there will be no sore throat apparent, a common feature of *scarlet fever attack*. The nose will not "run" and the eyes water, nor is there cough, as in the case of *measles*. The absence of back pain and sickness, which is a notable feature of *small-pox*, would probably exclude the notion of this disease being present,

whilst the more or less sudden development of the symptoms, after a very short period of incubation so to speak, will show that *typhoid fever* is probably not to be feared.

Treatment.—The treatment of this simple ailment is that of first of all clearing the bowels. This is best effected by a mixture of Epsom salts and sulphate of soda. Such a treatment, as has already been noted, tends to reduce the temperature. If the fever runs high aconite may be employed here. This remedy may be administered in one drop doses, each drop being given as a dose in a little water. This dose should be given, in the case of an adult, every fifteen minutes for an hour, and thereafter one drop dose given per hour if necessary for three or four hours.

If there is much general irritation a warm bath, carefully guarding the patient from any risk of chill, may be found to give relief by promoting the action of the skin. In this disease it will not be found usually necessary to make any great use of drugs. If a mixture calculated to be of service is, however, demanded for the further treatment of the patient, he may be recommended to use one composed of three drachms of aromatic spirits of ammonia, four ounces of the liquor of the citrate of ammonia, one ounce of syrup of lemon, and eight ounces of water. Of this mixture a tablespoonful should be given every three and four hours.

CHOLERA

True Cholera, also known as *Asiatic cholera* and *Epidemic cholera*, is not to be confused with another ailment more properly to be considered under the head of digestive troubles, and known as *British Cholera*. This latter disease, although sometimes producing fatal results, is as a rule of simple nature, and originates from some error in diet represented commonly by the eating of over ripe or under ripe fruit.

True Cholera is a highly serious disorder. It has had a long and interesting history. The first great development of this trouble occurred in India in 1817. It has since spread at fairly frequent intervals, from east to west, following generally the track of human journeyings.

Epidemics.—Its first appearance in Europe dates from the 26th October 1831, when, apparently, it was brought to England from Hamburg; thence it spread all over the country. After this epidemic, extending from 1831–2, a freedom from attack lasted until 1848–9. A third attack occurred during 1853–4. In 1865–6 it appeared to

have been represented in Britain for the last time. This latter epidemic was largely represented in London alone. In 1871–4 and 1884–7 Europe was affected, Britain however escaping attack. Cholera was responsible during its epidemic visitations for a very large mortality. The epidemic of 1848–9 is said to have caused over 53,000 deaths. In addition to this mortality, large numbers of deaths were also reported as due to diarrhœa itself The 1853–4 epidemic caused 20,000 deaths in England and Wales; the 1866 epidemic caused in London 5548 deaths; the total mortality for England at large being 14,378 deaths.

The Cause.—This disease is caused by a distinct microbe or bacillus, which from its curved shape has received the name of the "*comma bacillus.*" It was discovered in the bowel-discharges of patients by Dr. Robert Koch. These bacilli live in water which has been polluted by sewage matters, amongst which naturally are to be included the discharges of cholera patients. It is probably owing to the fact that water supplies of Indian villages are readily polluted by the excretion of inhabitants, that this disease is *endemic* in the country. It is in this case as if cholera matters passing from affected bodies into water were received into other bodies, thus keeping up a constant supply of cholera cases.

Certain authorities doubt whether or not this "comma microbe" is the real cause of the disease. They are inclined to believe that this germ occurs in healthy persons, a fact which seems to have been proved. However that may be, it is perfectly possible that a germ which in the healthy body develops no powers of producing disease, may very well show such powers when it is removed to another environment, namely, polluted water. One fact which appears to support Koch's view is that by means of injections of cultivations of the "comma bacillus" cholera can be produced in certain animals.

Indirect Causes.—There can be little doubt that indirect causes favouring the cause of cholera epidemics are found in the shape of insanitary surroundings. Thus, polluted water supplies and bad drainage give rise to a filth-laden soil, while overcrowding and the like may also be regarded as factors rendering the attack of this disease more readily achieved. It may be conveyed in milk through this fluid having been diluted with infected water. The great source of direct infection in cholera is the bowel-discharges. Hence these matters require instant and efficient disinfection so as to prevent them from gaining access to soil or water. It seems also highly probable that infection in cholera may occur through its germs becoming dried and being allowed to mingle with the air. It may be mentioned that cholera is not in itself a disease markedly infectious, and much the

same opinion may be expressed of another ailment, *typhoid fever*, where also we find infection derived from the bowel-discharges and also from the urine of patients.

In cholera and typhoid fever nurses in attendance on patients run little risk of infection, seeing that, unless the germs become dried and gain access to the air, or unless through carelessness in treating the bowel-discharges they may gain access to those in attendance on the patient, there is little chance of them reaching healthy persons. No doubt food is liable to be infected by cholera germs, and it is perfectly possible that flies allowed to gain access to the bowel-discharges of patients may convey the germs of this ailment, as they are certainly known to carry the microbes of other diseases and thus infect the articles of diet on which they swarm.

The Course of the Disease.—Cholera has a period of incubation (namely, the period between infection and the development of symptoms) of from one to three or five days. In certain cases cholera runs its course with an extreme and fatal rapidity. With regard to its ordinary course giddiness is first noticed with other symptoms. Vomiting also appears at an early stage. The bowel troubles then begin with rapid evacuation of the contents of the intestines. There is great collapse apparent; the skin is covered with a cold clammy perspiration; the vomiting and diarrhœa continue with severe internal pains; the prostration is extreme; the pulse fails, and the body is described as presenting the appearance of desiccation or "drying up." The symptoms always looked for when a suspicious case of cholera is being watched is that presented by the appearance of the motions. In the case of this disease they soon present an appearance known as that of "rice water stools." A great thirst exists, and the functions of the kidneys may be totally suppressed. The patient complains of cramp in the calves of the legs and feet, whilst, as the disease progresses, the temperature falls on account of the extreme exhaustion to which the patient has been subjected. If recovery takes place the first indication of this gratifying event will be an increased pulse, which up to this stage may hardly have been perceptible. The temperature also rises towards normal, and there is a general but gradual return to a state of relative safety. It may be frequently noted that previous to an epidemic of cholera, diarrhœa, apparently of an ordinary character, is apt to appear.

Treatment.—In so far as the treatment of this most serious disorder is concerned, it may be pointed out that, in the way of *prevention*, every attention should be paid to the purity of water-supplies. The immediate carrying away of all refuse and filth, and in so far as may be possible, a general improvement in the sanitation

as well as the food supplies of the poorer classes in great centres of population, are points to be borne in mind. It may be noted as an interesting fact, that when Glasgow was drinking Clyde water it suffered severely during two cholera epidemics. When the last epidemic affected the city, Clyde water had been exchanged for the pure supply the city now enjoys from Loch Katrine. The deaths during this latter period amounted to some sixty or seventy as compared with thousands in the preceding attacks.

Following upon the lesson taught us by these events, great attention should be paid in every cholera epidemic to the purity of the drinking water. This should either be properly filtered by means of a Berkefeld filter, or at least be invariably boiled immediately before use. It is advised that in a case of diarrhœa occurring during the prevalence or threatening of a cholera epidemic, this should be treated at once. An ordinary diarrhœa mixture may be employed for this purpose, composed for example of six ounces of chalk mixture, to which may be added one drachm of tincture of opium, half a drachm of compound cinnamon powder, and three drachms of powder of catechu. The dose of this is a tablespoonful, to be taken after every fluid motion.

In some cases the diarrhœa has been checked by the administration of rhubarb powder, or even by giving a dose of castor oil to which a few drops of tincture of opium or laudanum have been added. It will be understood that the treatment of a serious disorder like cholera is one which taxes all the energies of the physician. It is so rapid in its onset as well as in its course, that a very short delay may make all the difference between the safety of the patient and the reverse.

As regards the treatment for the pain in the bowels, *poultices* should be applied over the abdomen, a linseed poultice with mustard being preferable for this purpose. For the thirst ice should be given in small pieces and allowed to dissolve in the mouth.

Where the bodily heat begins to decrease rapidly a good plan is that of wrapping the patient in a sheet which has been wrung out of very hot water and sprinkled with turpentine, this supplying as it were a general fomentation to the whole body. Following up this treatment some physicians have treated the patient at this stage by placing him in a hot bath, the water of which has been heated to a little over 100 degrees. In cases of collapse brandy may be administered by the bowel.

Certain authorities approve of the administration of carbolic acid in a dose of three drops in water, or combined with other medicines, repeated each hour for three or four hours; but the administration of such a remedy requires great care, and is a matter for the medical man alone. Camphor has also had a high reputation in respect of its

utility in very severe cases. It has been given by injecting it under the skin in one grain doses, in 20 minims of olive oil every hour. In other cases the essence or spirit of camphor has been administered by the mouth. Turpentine has also been regarded as useful in cholera. An extremely handy preparation adapted for the relief of ordinary diarrhœa, and one which has attained in the hands of Indian practitioners a large amount of success, is that known as *chlorodyne.* The dose of this preparation varies from say 15 or 20 to 30 drops, given in water, and the dose repeated in two hours if necessary. In addition to its effect in checking diarrhœa, it also exercises other effects due to the admixture of substances it contains.

Saline Treatment.—A treatment which was much discussed in cholera epidemics abroad is that which relies upon saline purgatives as constituting reliable remedies. The object of this treatment had for its aim the clearing of the bowels of what may be regarded as the cholera poison. Early in an attack an ordinary seidlitz powder was given, the patient being made to take weak beef-tea to which a fair amount of salt was added. His drink consisted of soda-water, or even of pure water given as often as required. In later stages of the disease a mixture of salt one scruple, bicarbonate of soda half a drachm, and chlorate of potass seven grains, was given every half-hour, whilst in extreme cases the same mixture dissolved in hot water (105 degrees) was administered by the bowel. Considering that this disease appears to produce its effect very largely by practically draining the body of its water through the bowel, the *rationale* of this treatment can be understood. Also it may be noted that where solutions of salt have been largely employed by injection into the blood in cases where great losses of that fluid are sustained, the effect is to cause reaction on the part of the patient and thus enable him to tide over his extremity. Finally we may refer here to recent work in discovering an inoculation by way of preventing cholera. Haffkine, by preparing an *antitoxin* from cholera germs, demonstrated that when used for inoculation, this treatment prevented attack. It has yet, however, to be shown that it is of any service as a cure when the disease has become established.

PLAGUE

A brief reference to this disease may be made at this stage, more especially as cases of plague have lately occurred in this country. It would appear that the "Plague" represents a very ancient disease, and is probably that which devastated London before the occurrence of the Great Fire.

The *bacillus* or *microbe* of this disease has been discovered. It appears to select for its attack the lymphatic glands of the body, which swell and form what are known as *buboes*—hence the name *Bubonic Plague* which has been bestowed upon this disease. Affected persons are liable, however, to the attack of other complaints, of which inflammation of the lungs is perhaps the most prominent example.

Infection.—Infection chiefly comes from rats, and there seems to be little doubt that the fleas which exist on the rats obtain the germs from the blood of the animals, the insects conveying the disease in turn to human beings whom they bite.

Little can be said regarding the treatment of this complaint, the aim of the physician being simply that of attacking the symptons as they appear, and thus counteracting the tendency to collapse and prostration by the administration of a nourishing diet. Quinine has been used as a drug in the course of the treatment.

It may be added that a *serum* or *antitoxin* has been prepared from the germs of this particular affection. Happily the serum treatment does not merely prevent attack as in the case of cholera, but likewise appears to possess a direct value in the way of cure.

TYPHOID FEVER

Typhoid fever is otherwise known as *Enteric fever*, the latter term having reference to the fact that the chief seat of attack in the course of this disease is the lining membrane of the smaller intestine or bowel. For a considerable period this fever was confused with another and quite different ailment—viz., *typhus fever*.

In 1820 a French physician directed attention to the fact that this disease had its seat in the glands of the small intestine (Fig. 55). He further showed that the disease was common to collections of individuals, as in the case of armies. In 1835 Dr. Perry, of Glasgow, showed that there were essential differences between the two fevers. Other observers laid stress on the fact that the symptoms of the one disease were different from the symptoms of the other. It was left, however, for Sir William Jenner, between 1849 and 1851, to show definitely that typhoid fever was essentially a different disease from typhus fever. The symptoms, he showed by careful analysis, were different essentially in the two diseases, and that in all probability the causes of the ailments were as widely varied as the symptoms and signs of each. Dr. Budd, of Bristol, also directed attention, at a later period, to the fact that the chief means whereby typhoid fever

was disseminated was by means of polluted water, an opinion supported, it need hardly be said, by all subsequent experience.

The Germ.—The *bacillus* or *germ* of typhoid fever has been duly described. In size, of course, it is of microscopic dimensions. It is known as *Eberth's bacillus* (Fig. 56). It is a rod-like microbe, but of short form. It is capable of executing independent movements in water and in other fluids through the possession of thread-like processes known as *flagella*. It readily breeds and multiplies, not merely in water, but in milk and in other fluids. A very interesting point in connection with the germ of typhoid fever is found in the fact that a certain bacillus, known as the *Bacillus coli communis*, is believed by some authorities to present a certain definite relationship to that which is associated with typhoid fever. The *bacillus coli communis* appears to be a natural tenant of the human bowel in a healthy state. Seeing that it can be demonstrated to exist in all healthy individuals, it cannot be said that of itself this latter germ has any pathogenic or disease-producing powers. When, however, this harmless germ, whose natural habitat is the human bowel, is transferred to another environment, represented by sewage and decaying matter, it is believed by some sanitarians that it undergoes a process of development or evolution transforming it into the bacillus of typhoid fever. This view of matters has yet to be proved, but from what is known to occur in other groups of microbes this result may be regarded as perfectly possible and feasible. The health lesson which is here taught us is the possibility, at least, of a harmless germ becoming transferred into a disease-producing one; and a further hint is conveyed to us that all contamination of water, and especially of sewage, by healthy excreta should be avoided as a possible cause of the disease under consideration. A high authority on public health assumes that the bacilli of typhoid fever given off in the bowel-discharges of the patient are not immediately infectious, and are therefore not capable at once of conveying the disease to healthy persons. This authority further maintains that certain changes and modifications must be

Fig. 54.—The Bacilli or Germs of Typhoid Fever (highly magnified).

represented in its history before it can become capable when swallowed of producing the disease anew. If such changes be referred to its further growth and modification amongst sewage matters, such a fact would tend to support the view already expressed that the typhoid germ in reality represents an otherwise harmless germ altered to a disease-producing one through being placed in a sewage environment.

Infection.—With regard to the sources of infection in typhoid fever, these are fairly numerous. In the first rank may be placed *a polluted water-supply.* Such a supply is rendered infectious through the escape into it of typhoid germs derived from cases of the fever. Numerous instances are noted in public health records of a whole epidemic, involving thousands of cases, being set up by pollution of a water-supply from one single case of this fever. The case of Darwen, in Lancashire, may be quoted in this connection. The water-supply of this town was polluted by the excretions of a typhoid fever patient residing in a house the drains of which communicated with the main pipe leading to the town. Over 2000 cases resulted in the town from this source of infection. In another case in 1879 an outbreak of this fever took place at Redhill and Caterham. It was clearly shown that this latter epidemic was due to pollution of an outflow pipe from the Caterham waterworks, the water having been polluted by a workman engaged at these works, and who had suffered from a mild attack of this fever.

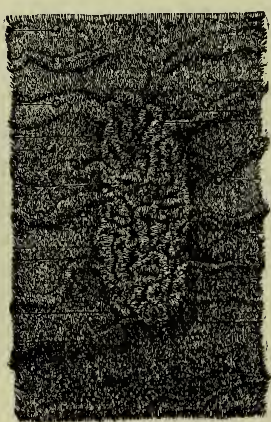


Fig. 55.—A Gland (Peyer's Patch) of the Small Intestine or Bowel. Typhoid Fever specially attacks these Glands.

Milk and Typhoid Fever.—A second source of infection is that by means of milk. Indirectly this mode of conveyance of the fever may also be attributed to an infected water-supply. When the water in connection with a dairy farm is not of pure condition, we can well understand how this fever may be conveyed by milk through polluted water being employed to wash the dairy vessels.

Foods and Infection.—Another source of infection may be mentioned in the shape of certain foods. It has been proved by innumerable instances that typhoid fever can be conveyed to us, for example, through the medium of *oysters.* In this case these bivalves have been laid down in beds to which water containing the sewage of towns and the germs of typhoid fever have had access. It would

appear that the germs of typhoid fever may exist in the oyster for a certain period, and experiments show that if an infected oyster be removed to pure sea air the germs will die in about fourteen days. In the interval, however, if such an oyster be consumed, a grave risk of typhoid infection is necessarily incurred. The movement which has recently taken place with the view of securing freedom from contamination of oyster-beds by sewage is therefore one which must exercise an appreciable effect on the prevention of this disease.

Watercress. — The consumption of *watercress* is also to be regarded with a certain amount of suspicion in respect of the possibilities of infection. These plants often grow in water liable to be contaminated by the sewage of filth, and have been laid very gravely under suspicion. It has been pointed out by a foreign authority that typhoid germs, by means of their thread-like processes, may be capable of a considerable amount of adhesive power to the leaves of this plant; hence the necessity for ensuring that all vegetable matter, watercress included, should be subjected to a thorough process of cleansing before being consumed.

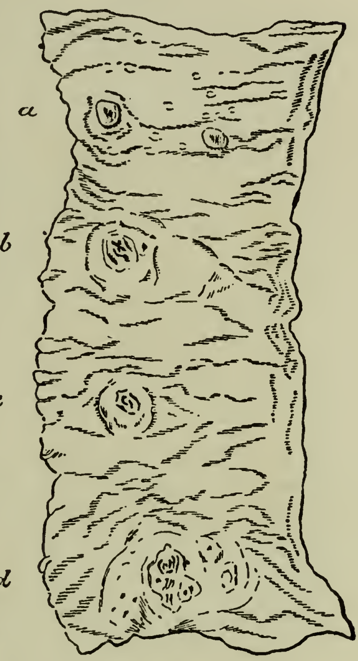


Fig. 56.—A Portion of the Bowel as affected by Typhoid Fever. At *a* the Peyer's Patches are seen to be Perforated through; at *b*, *c*, and *d*, successive Stages of Ulceration are represented.

Houses and Typhoid Fever.—It has been long an open question whether typhoid fever can be conveyed to man from sewer gases and the air of drains transmitted through defective trapping to dwelling-houses. All authorities are agreed that in cases where a dwelling-house is flooded with sewage gases a low state of health is thereby engendered in the inmates. This low condition of health, no doubt, predisposes those subjected to the influence in question to the attack of many diseases. It is, however, another and a different question whether any special disease can be conveyed directly through the breathing of sewer air. It would appear, on ordinary grounds, that such a mode of infection, if not impossible, is at least of rare or uncommon occurrence; but it has been added that typhoid germs might be given off to the air and be inhaled or swallowed, where, in the course of the run of the sewage along a drain, any fall of the drain existed. Here, the fall producing a very fine spray, which passes into the air, is credited with the power of diffusing into the

atmosphere the germs of this fever, and of other ailments as well. Of the latter, diphtheria might be cited as an example. The moral of this observation must be, of course, clear to every one. It is that which advises strict attention being paid to all the sanitary arrangements of the dwelling-house by way of ensuring that the home, by means of efficient trapping, is perfectly cut off from communication with the sewers. In connection with the sources of typhoid fever it may, like diphtheria, be regarded as a filth disease. Strict attention should also be paid to the removal from the abodes of men of all kinds of filth and refuse.

Soil and Typhoid Fever.—It is notable that typhoid fever is a disease much more prevalent in cities than in country districts, and if any locality be noted for the extreme prevalence of this disease the persons who come to reside in that locality for the first time are found to be more subject to attack than those who have resided therein for a certain period. With regard to the question of *soil*, there can be little doubt that ground polluted by sewage contamination is liable to retain a certain infective power in the case of this disease for long periods. The continued prevalence of typhoid fever in Dublin, for example, is attributed to the fact that the soil of that city is largely sewage-logged. German observers have made a strong point of the relation between the amount and movement of ground water and the occurrence of this fever. Much here must depend of course upon the amount of the water retained by the soil and on the character of the soil itself; but it is certain that, apart from all other questions connected with subsoil water, the occurrence of this fever is largely promoted by any ground occupied by human dwellings being allowed to become infiltrated with sewage matters. Such a soil, in other words, confers a ready breeding-place for the germs of the disease.

The Typhoid Season.—Typhoid fever is much more commonly found developed in the autumn season of the year than at other periods (see Fig. 1). It appears to affect males more fatally than females, but it would seem that the death-rate is greater amongst the female sex from the fourth year to the twentieth year. It is greater amongst males, according to certain figures, from the fifth to the twenty-fifth year, and also greater amongst females at all other ages. The Typhoid period has been described as that between ten and thirty years of age. The period of development of this fever is that when fruits are mostly consumed. Whether any causal connection exists between this fact and the occurrence of the malady is an open question, but at least care in the consumption of fruit and in

seeing that all fruit and vegetables are properly cleansed is a point worthy of consideration.

Infection.—With reference to the *chances of infection* from this fever, the remark made regarding cholera that it is not a directly contagious disease holds good of typhoid fever. Doctors and nurses in attendance on typhoid cases are not very liable to infection. It has been the custom in hospitals to treat typhoid cases side by side with other cases of other diseases. This latter practice, however, is being somewhat discouraged, and as the germs are given off from the body of a patient, not merely in the bowel-discharges but in the urine as well, and as considerable difficulty may be experienced in the exact and instant disinfection of these discharges, the modern tendency of hospital management is to place typhoid patients in a ward by themselves. There can be little doubt that clothing and body linen which have been stained by typhoid discharges, and carelessly treated in the way of disinfection, are liable to convey the disease. So much has the personal aspect of this fever impressed Dr. Koch, that he has expressed the opinion that the accurate personal care of each individual case of typhoid fever in the way of disinfection, and separation from all other cases, and from cases of other diseases would speedily ensure its total abolition.

Incubation.—This fever exhibits a fairly definite period of incubation, extending as a rule from six or eight to twelve to fourteen days. There are, however, wide variations to be noted in this period with regard to all fevers. A very short period of incubation is that extending from two or three days only, but from three to four weeks after infection may elapse before the active symptoms of the disease appear. It is said that the incubation period is extremely short when polluted water has been the medium of infection. The onset of this disease is insidious and prolonged. The patient, in other words, passes from a state of health to one of disease by very gradual stages. Assuming that the average period of incubation is fourteen days ; during that period the person who has been infected with the germs of this disease will appear listless. He will exhibit a desire to rest, and an inability to perform his ordinary work will constitute a marked feature of his state, whilst there will also be a tendency to keep to bed for unwonted periods. At first *the pulse* is not quickened, but very early in the incubation stage it will be found, if the thermometer is used, that the temperature, *taken at night*, is always higher than that in the morning. This difference will amount to a degree or more ; and it may be further noted that a higher evening temperature is a definite symptom throughout the whole course of typhoid fever.

Temperature.—When the fever is actually developed, the temperature may attain to 105° Fahr. at the end of the first week. It is about the third week that the temperature begins to be lowered, whilst about the fourth week of the fever it may have returned to its normal state. The pulse naturally quickens when the feverish stage is reached. A high pulse is to be regarded as a symptom of gravity, especially when this condition is maintained. In typhoid fever it is not unusual to find a double pulse. This latter condition is called a *dicrotic pulse*, a characteristic of this state being that a tendency exists for the beats of the artery to double themselves.

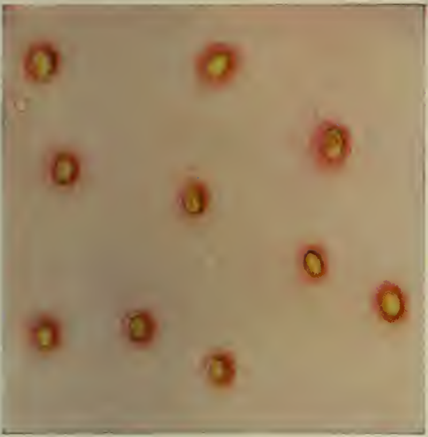
Other Symptoms.—In the preliminary stages of this disease headache will exist with loss of appetite. The appearance of the tongue is characteristic. It becomes contracted, and is covered with a yellowish fur, whilst its tip and its edges are of a reddish tint. The eruption appears on the seventh or eighth day after the fever has declared itself. It is of very characteristic appearance, and appears on the abdomen or belly, whilst it may also extend to the chest and limbs. It consists of small rose-coloured spots of circular form. When they are pressed, the spots disappear for a period, reappearing when the pressure ceases. These spots disappear, but tend to be succeeded by others, a regular succession of them being developed during the course of the fever. The probability is that each crop of spots represents what may be regarded as an increase in the severity or course of the disease. It is said that in the case of children the eruption may be very ill defined or altogether absent. About the thirtieth day of the fever the eruption disappears for good. A premonitory symptom of typhoid fever, and one which is found at later stages in the disease, is that of pain in the lower part of the belly on the right side. When this is pressed upon, a gurgling sound may be perceived.

The *motions* in typhoid fever are extremely characteristic. Diarrhœa is generally represented, and when the fever has fully declared itself, the motions are described as of a "pea-soup" character. It will be understood that as the seat of this disease is typically the small intestine or bowel, the glands here are specially attacked by its germs. Inflammation and ulceration of these glands (Fig. 55) takes place, and occasionally the stools will be found to exhibit blood as part of their composition. A serious symptom in the case of this ailment is seen where any quantity of blood is passed, and it will be understood that a grave complication and danger of the disease is that which is represented by the ulceration tending to produce *perforation of the bowel*. In this case, as in the case of ulcer of the stomach, the bowel gives way and fatal inflammation may be set up. The spleen and the liver are apt to be enlarged in the case of this disease, whilst it would even appear that the

FEVERS.

MEASLES.

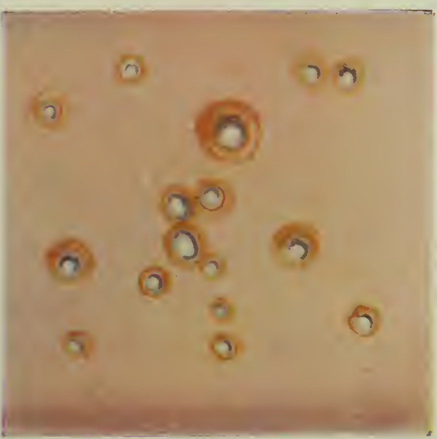
TYPHOID OR ENTERIC FEVER.



SMALL-POX—AFTER VACCINATION.

SMALL-POX—UNVACCINATED CHILD.

VACCINATION VESICLES ABOUT 10TH DAY.



CHICKEN-POX.

muscular system is liable to be affected by a process of degeneration. Another complication liable to occur is represented by *bronchitis*.

Progress of the Disease.—The dangerous period of typhoid fever is that of the third week. It is here that perforation of the bowel is more likely to occur, with bleeding from the nose or an attack of bronchitis, or it may be a development of inflammation of the lungs. In the fourth week in a favourable case the temperature falls and becomes normal. In a mild case improvement may be seen in the second week of the disease. Delirium occurring in typhoid fever is always to be regarded as a serious symptom.

Widal's Reaction.—A test which has been applied by way of ascertaining the occurrence of typhoid fever in doubtful cases is that known as Widal's reaction. This test, applied by the physician, consists in adding the blood fluid of a typhoid patient to a cultivation of typhoid bacilli. If typhoid fever be present, the bacilli lose their power of movement, and tend to aggregate themselves together in masses or clumps. This test can be applied in the second week of the fever. It may be said that if the temperature does not rise in this fever above 103 degrees, the case may be regarded as mild and tending towards a favourable termination. A higher temperature during the second week, and especially if maintained later, is to be regarded as a grave symptom, especially if bleeding from the bowel takes place.

Treatment.—One notable feature with regard to the *treatment* of this fever is that contained in the advice, that whenever the presence of the ailment is suspected the patient should seek repose in bed at the earliest possible period. Statistics seem to prove that the chances of recovery increase proportionately with the early period at which complete repose and rest have been obtained. One series of these statistics shows us that in the case of hospital patients, of those treated for the first time at the end of the fourth day, 5 per cent. die. Of those treated for the first time between the fourth and eleventh day, 13 per cent. exhibit a fatal issue; whilst if the treatment is begun after the eleventh day, 28 per cent. are liable to show a fatal result.

It may here be noted that certain mild cases of this disorder are liable to occur, the patient in such cases although by no means exhibiting a state of health yet being able to move about. Such cases are termed those of *ambulant typhoid.* It need hardly be said that such persons form a source of grave danger to the community. Whilst the disease is not recognised, and whilst the symptoms are set down to a low state of health, the bowel-discharges are capable nevertheless of conveying infection. Hence the difficulty of the physician in dealing

with this disease largely arises from the fact that its symptoms are frequently masked and are otherwise not readily recognised.

Nursing.—An important point in the treatment of typhoid fever is connected with the question of nursing and food. If any disease may be said to depend for a successful issue upon accurate care on the part of the nurse it is typhoid fever. Absolute rest is enjoined so as to save the patient from all exertion. Even after convalescence has been established, rest in bed is necessary, and this point is rendered all the more worthy of attention from the circumstance that relapses are not uncommon where a tendency to allow the patient to rise too early from bed is represented. A medical rule makes it imperative that the patient should not be allowed to get up until the night temperature has been normal for about three weeks.

Food in Typhoid Fever.—Equally important is the question of *food.* It will be understood that as typhoid fever especially affects the lining membrane of the bowel, besides exercising a weakening effect on the whole digestive system, all attempts to administer ordinary articles of diet would be attended by very serious results indeed. A fatal issue has been frequently brought about in typhoid fever even at a late stage of the ailment through the injudicious kindness of friends visiting patients and bringing with them articles of diet of a solid character. After a long period of subsistence on liquid foods, the patient who is recovering craves for something of a more solid character. If in the absence of the doctor or nurse any articles of this latter kind are conveyed to a patient such a practice will be followed by an immediate rise of temperature, and by other symptoms indicating a relapse, which as often as not may end fatally. This latter caution should therefore be borne clearly in mind by all who have anything to do with the treatment of a typhoid case. *Milk* is the food on which the typhoid fever patient is to be typically fed. It should be given at regular intervals, a fair amount being half a tumblerful every two hours, making in all about three pints or so for the twenty-four hours. The milk may be pre-digested or *peptonized* after the method which will be duly described in the section of this work dealing with the preparation of invalid foods. The rule is that no solid food whatever should be given until the temperature both morning and night has maintained its normal degree for at least a week. The milk food may then have added to it beef-tea, fish and soup, or boiled chicken. Tea is not absolutely prohibited to typhoid patients, but it should contain a large quantity of milk. The yolk and white of eggs beaten up may also be used either by themselves or added to other light articles of diet.

In so far as regards *thirst,* iced water may be given in sips, or even

plain water. There is no objection to the flavouring of any drink with a little lemon juice. A physician has said that the rule for feeding in typhoid fever is that no food should be given which would not readily pass through a fine sieve.

Nursing Caution.—The duties of the nurse in the case of this fever in addition to attention in the feeding of the patient will also consist very largely in making due arrangement for the use of the bed-pan. The patient is not to be allowed to get up, and is to be carefully guarded against chills. The remarks previously made regarding the necessity for the disinfection of the patient's motions must be clearly borne in mind as an essential part of the nurse's duties. For the purpose of disinfecting the stools, pure carbolic acid may be used, the motions being afterwards buried in the earth in preference to being allowed to escape into the drains. Izal is also an excellent disinfectant, used in the preparation of say 1 to 100 of water. It is also of importance, as already stated, that the urine be likewise disinfected.

Medical Treatment.—With regard to the other details of medical treatment most physicians are agreed that when the existence of this disease is certain the bowels should be cleared. This practice is founded on common-sense principles. The ulceration of the bowels will undoubtedly have a better chance of undergoing favourable changes in the absence of any matter in the intestine, hence one or two doses of calomel, of say four grains each, may be administered at the commencement. If the diarrhœa of this fever be particularly troublesome, it is advised that an injection or enema, consisting of four ounces of starch and water, will prove effectual in limiting bowel action. Sometimes to this starch enema there are added five or six drops of tincture of opium. An enema thus prepared may be administered night and morning after the bed-pan has been used. One lead and opium pill may also be administered after each motion in the case of excessive diarrhœa. Where bleeding from the bowels takes place additional care naturally is required in the treatment of the patient. In such a case the milk had better be stopped and replaced by meat essence or invalid bovril. Cold may be applied to the belly by means of iced bags, and the movement of the bowels may be restricted by giving some preparation such as the following: fifteen grains of gallic acid and five minims of laudanum to be administered in cold or iced water, especially where bleeding takes place. Where great pain and distension of the belly exists, a symptom likely to occur during the third week of the fever, oil of turpentine forms the best remedy. The dose of this substance is ten minims, and this may be administered every two or three hours

in milk. Hot fomentations sprinkled with turpentine may also be applied to the abdomen.

Cold Baths.—The use of cold baths in this fever has largely increased of late years. If the temperature keeps high and rises above 103 or 104 degrees, a tepid bath varying from 80 to 90 degrees Fahr. may be given every three hours, the patient remaining in the bath for about ten minutes. Cold sponging in such cases has sometimes been substituted for the tepid bath. Where the pulse seems to fail and a state of collapse is inevitable, the physician will probably prescribe a stimulant such as brandy or whisky.

Internal Disinfection.—In the case of typhoid fever a phase of treatment has been that of attempting to influence the bowel towards its healing by giving substances of a disinfectant kind. The drug which has been mostly used for this purpose of late years has been *salol,* whilst carbolic acid and other substances have also been employed. The dose of salol is ten grains, and this is administered three times a day in water. Carbolic acid in the shape of a pill prepared with charcoal and properly coated has also been employed for this purpose. These pills contain from 1½ to 2 grains of the acid. One authority recommends that three or four of the 2 grain pills should be given each day, or double the number of the 1½ grain pills may be administered in this period. A remedy which has been specially tried on the Continent for this purpose is *carbonate of guaiacol.* This is given in a dose of from 2 to 2½ grains thrice daily. It is said that if employed at the beginning of the fever and onwards, very favourable results are obtained, whilst the diarrhœa is said to be limited. A medical rule here is found in the observation that such antiseptic or disinfectant remedies applied directly to the bowel are not permissible where the fever has already run a certain amount of its course.

A Caution.—In connection with typhoid fever an important caution may here be given. It is undoubtedly a common practice on the inroad of most diseases to administer a purge. Undoubtedly, as has already been pointed out in many cases of illness, an ordinary purge acts with advantage. In respect of typhoid fever the practice of purging would probably act in an injurious fashion. If therefore any case is presented in which the symptoms of typhoid fever are present, and in which there is pain with gurgling at the right side of the belly below with rise of temperature at night, headache, inability to perform work, and possibly constipation, it will be safer to avoid giving a purgative alone, leaving the administration of calomel as already indicated in the treatment of this fever by way of clearing the bowels for the decision of the medical man.

TYPHUS FEVER

As has already been remarked, this fever was for a long period confused with the typhoid disease. It may be useful to note the prominent differences which differentiate the two ailments. In the case of typhoid fever we find a liability especially between the ages of 15 and 25 of both sexes to attack. In that of typhus males are more liable to be attacked than females, and especially between the ages of 25 and 35. The cause of typhoid fever has been shown to depend chiefly upon the drinking of water containing the germs of the disease, and typhoid is moreover an ailment which attacks persons in all ranks of life. Typhus, on the other hand, is typically a disease of the poor of the slums and overcrowded districts; associated with these conditions are others represented by filth and overcrowding. The germ of typhus fever, although unknown to science, is believed with great probability to flourish and grow amidst the foul substances given off from the human lungs and skin, and allowed to accumulate in places where ventilation is defective. With regard to the *onset* of this disease we have seen that typhoid fever attacks its victims in an insidious way after an incubation period of about fourteen days. In the case of typhus fever, the incubation varies from one to twelve days, but the onset of the disease is extremely sudden.

With regard to the termination of the two diseases we find that recovery in typhoid fever is gradual and is not marked by any prominent symptom. This mode of the termination of a disease is known to the medical men as *lysis*. On the other hand, in the case of typhus fever the disease ends about the fourteenth day from its commencement by what is called a *crisis*, a chief feature of which may be seen in sweating or in a prolonged and refreshing sleep. In typhus fever also the nervous system appears to be intimately affected, and delirium is common. In typhoid fever as a rule delirium is absent, save in grave cases, and an attack on the nervous system does not form a prominent feature of the ailment. In typhus fever the pupils of the eye are contracted, whereas in typhoid they are extended or dilated. The diarrhœa of the typhoid fever is well marked, as has already been explained, but in typhus fever the bowels as a rule are constipated.

Temperature.—With reference to the *temperature* in typhus fever, we find that it rapidly rises in the first week and may attain to 104 or 105 degrees. About the twelfth day it falls rapidly, leading to the crisis or termination of the disease on the fourteenth. In typhoid fever, as we have seen, the temperature varies throughout

the disease, rising about two degrees in the evening and falling one degree in the morning for a certain period.

The Eruption.—With respect to the rash in typhus fever, this also is in its way characteristic. It makes its appearance from the fifth to the seventh day of the fever, and appears on the trunk and the legs and arms. More rarely is the face affected. Its colour is described as that of a dark mulberry tint. As in the case of typhoid fever, the spots disappear on pressure but speedily reappear when the pressure is removed. The rash in typhus also exhibits a peculiar development. In a few days at most the colour of the spots becomes much darker, and if pressure be then applied to them they do not disappear but only acquire a lighter tint. Also we find that the spots may, through the eruption of blood into them, become of still darker colour, and are then termed *petechiæ.* It may be noted when spots of this description are developed *on the back of the hands,* the beginning of typhus fever is known as a matter of certainty. In typhus fever also we may find a somewhat mottled appearance by reason of groups of the spots running into one another. The rash persists until the fourteenth day of the fever, and is not as in typhoid characterised by the appearance of successive crops. These symptoms suffice to make clear the distinction between the two diseases.

With regard to other features of this complaint it may be noted that *delirium or wandering of the mind* is a characteristic of this fever, whilst the countenance, instead of being fairly bright and intelligent, as in the case of typhoid, is dull and heavy. The eyelids are swollen, and the patient exists in a confused and semi-sleepy state. In this fever a high temperature of 108 or even of a higher degree is to be viewed as a highly serious symptom. The pulse increases with the progress of the disease.

Premonitory Signs.—The *preliminary symptoms* of this fever are generally manifested by severe headache with pains in the back or limbs. There is a want of energy present, whilst the tongue is coated with a white fur, and constipation is also likely to be represented.

A foul tongue is very characteristic of this fever. Typhus is an ailment which is apt to be accompanied by complications. Thus inflammation of the joints may occur with swellings in the neck region, whilst lung troubles of grave nature are also liable to supervene. Brain-complications are also not uncommon in the case of this disease.

There can be no doubt that typhus fever was that formerly known under the name of "gaol fever." The state of the prisons two hundred years ago was of course disgraceful, and typhus fever found a ready soil in the filth and overcrowding which characterised

these establishments. Occasionally in times of famine typhus has been noted to succeed *relapsing* or *famine fever*. Typhus mostly attacks males, and the risk of death seems to increase from childhood to about 50 years of age.

Infection.—We may notice here another important difference between typhus fever and typhoid. The latter has been shown to be an ailment not directly infectious, its contagion being conveyed mostly from polluted water and milk to which the germs have gained access. In the case of typhoid fever, therefore, we may assume that where a large number of cases occur, the source of one infection has been the source of all, exemplified by a large number of people drinking the same polluted water. It must be noted in the case of typhus that this last *is an eminently infectious disease.* Infection is no doubt given off not merely by the breath but also by the excretions of the skin, and a reliable opinion states that whilst this fever may be infectious from the first, risk of acquiring it is more liable to occur after the first week. Not only is infection possible through contact with the patient, but we must remember that his personal clothing and bed clothing are also liable to convey the disease. Typhus fever, as far as experience goes, has not been shown capable of being conveyed by water, milk, or food at large. If one attack of typhus does not protect the body against another, it is relatively uncommon to find a second attack occurring.

Prevention.—With regard to the *prevention* of typhus, we see that free ventilation is one of the most powerful agents in preventing the propagation of this ailment. Reference has already been made to its generation in overcrowded and dirty places where poverty reigns supreme. The abolition of slums, and the free ventilation of such places as common lodging-houses and the dwellings of the poor at large, would undoubtedly exercise a very beneficial effect in the way of preventing the development of the germs of this ailment.

Treatment.—With regard to *treatment*, we here notice the high importance of at once isolating and separating a typhus fever patient from all contact with his neighbours. The case of the tramp already quoted, who, suffering from this fever yet contrives to crawl from place to place, infecting those with whom he comes in contact, offers a striking commentary on the easy fashion in which this disease may be induced. It has been said that where a person has been exposed to the infection of typhus fever, the administration of an emetic (or substance producing vomiting) may ward off an attack, and this hint may be borne in mind.

In this disease the administration of a purgative to start with is warranted by medical experience. A dose of rhubarb powder of

from thirty to sixty grains may be administered. Cold applied to the head will relieve the tension and delirium, and in a case of typhus it is usual for the head to be shaved. The *diet* will largely consist of milk given in small quantities. About five pints daily may be set down as the amount to be consumed. For the thirst, pure water or lemonade may be administered. If *lung complications* occur, hot poultices must be applied to the chest. The room in which the patient is treated should be darkened, so as to avoid all sources of irritation.

Baths.—In connection with the treatment of typhus fever the use of baths of a temperature of about 87 degrees, given morning and night, has been highly spoken of. This treatment is especially recommended if the temperature rises to 103 degrees or above. The bath of course must be given in the patient's room. Where medicine is required for the relief of brain and other symptoms the following prescription may be found useful: Diluted hydrobromic acid, half an ounce; sulphate of quinine, half a drachm; water up to eight ounces; one-eighth part to be administered every four hours.

Alcohol.—In connection with typhus fever two points are generally regarded as of importance. The first of these is connected with the administration of alcohol. Some physicians disapprove of the administration of alcohol in this fever, but the safest guide here will certainly be the condition of the patient. Where there is great prostration and loss of strength, alcohol may be given, the effects of the administration being duly noted. If the temperature is thereby increased and great restlessness prevails, the use of alcohol may be regarded as inadmissible. On the other hand, if the alcohol produces quiet, and in general seems to affect the patient in a favourable fashion, it may be continued. Small doses alone are necessary. A dessert-spoonful of brandy diluted with water represents an ordinary dose, and the time of administration will naturally depend upon the condition of the patient.

Bed-sores.—The second point refers to the liability in the case of this fever to the formation of bed-sores. These are caused by the body lying long in one position. The use of a water bed is to be recommended in such a case as tending to equalise the pressure. The nurse may apply cotton-wool strapped by means of sticking-plaster over the parts on which the body rests. These parts should be frequently examined, and on the first appearance of any tenderness they should be dressed with a mixture of alum to which is added white of an egg and brandy. Another application for bed-sores is glycerine of alum. If the sores should come to a head and exhibit a

raw surface they should be treated with a charcoal poultice. Thereafter, by way of healing them, iodoform powder should be dusted over them.

RELAPSING FEVER

This fever was formerly known under the name of *Famine fever*, on account of its association with periods of poverty, distress, and lack of food. It was also termed *Recurrent typhus fever*, a name applied to it from the fact, already mentioned, that epidemics of this disease were generally followed by attacks of the graver ailment. Relapsing fever has appeared in epidemics at various times in Britain and in other lands, but apparently since the year 1871 it has been largely in abeyance.

As in the case of typhoid fever, it would appear that this disease demands, as its predisposing conditions, dirt, overcrowding, and poverty. There can be little doubt that when the nutrition of the body, as in the case of famine, passes below a certain point, and when the other conditions mentioned are also present, the germs of this fever acquire increased powers of growth, and outbreaks are thus easily originated. The germ of this disease is known as a *spirillum*. Microbes of this character are so named because of their spiral or corkscrew shape.

An interesting feature regarding this germ is found in the fact that it was first described by Obermeier. He discovered it in the blood of patients suffering from the disease. It was also observed that when the fever had run its course, the development of the microbes appeared to decline before a relapse took place. The microbes disappeared from the blood with the fall of the temperature. The probability is that they really retire to some organ of the body, preferably the spleen, and after lying dormant for a time, they give origin to another crop of germs. When these latter are liberated into the blood a "relapse" takes place. These germs move about quickly and actively in the blood. The period of incubation of this fever varies from five to seven days, and it appears to attack males more frequently than females. The most common period of life in which it occurs is either in early years or from about the twentieth to the thirtieth year. Beyond the thirtieth year it is scarcely ever seen.

Symptoms.—As in the case of typhus fever, relapsing fever exhibits a sudden onset. The patient shivers, there is a severe headache in the forehead region, while pains in the back exist, and before the first day is over the temperature may have run up to 104 degrees. The pulse is also much quickened and the skin of a moist character.

The tongue is coated, but it does not exhibit the characteristic appearance seen in typhoid fever. Constipation as a rule exists in the early stages of this ailment. After the fifth day of the fever it would appear that the symptoms increase in their intensity, and the temperature may rise to 107 or 108 degrees, being higher in the evening than in the morning.

A certain amount of *delirium* may exist in this fever, but after the fifth night *a profuse sweating* occurs. Then the temperature falls, the symptoms abate, and the patient is well, save for extreme weakness. The liver and the spleen appear to be enlarged in this disease, and it is noticed that an increase in the size of these organs takes place as the day progresses. This is at the commencement of a seizure, at the close of which the spleen appears to diminish in size.

The Relapse.—*For a week* the patient is fairly well. Then comes a "relapse," from the occurrence of which the fever takes its name. This relapse begins generally at night, but a second attack exhibits a less severe course, and is more quickly ended than the first. Four or five relapses may occur in a case of this disease. If the second relapse ends the trouble, the patient will undergo a fairly long period of convalescence, and will not attain his usual state of health until after the lapse of five or six weeks. This fever is not a remarkably fatal disease. When death occurs it may either be due to the fever itself, to inflammation of the lungs, or to spleen troubles. Jaundice, as well as diarrhœa, may be associated with this ailment.

Treatment.—The *treatment* of this disease is of fairly simple nature. It might be supposed that from the nature of this trouble quinine would be a useful drug. Inasmuch as relapsing fever presents certain points of likeness to *malarial fever*, in which quinine is found to be of inestimable value, it may well be thought that this drug would be serviceable. This, however, is not the case. Quinine and iron may certainly be used as a tonic expediting the process of recovery, but quinine of itself, administered during the course of the fever, does not appear to exercise any specific effect in causing the death or the non-development of the microbes in the blood.

The main object of the treatment in relapsing fever is to give the patient complete rest. The thirst may be assuaged by giving soda-water, whilst cold may be applied to the head by way of relieving the head symptoms. The spleen affected in this disease is situated on the left-hand side of the stomach. If pain exists in this region hot poultices may be applied, while some authorities recommend the application of ice. The food will consist largely of milk, whilst strong soups, properly made beef-tea, and the like, and beaten-up

eggs may also be given. Stimulants are also recommended as part of the treatment of relapsing fever. These should be given in small quantities, and as may be necessary to sustain the strength of the patient. A prescription which is found useful in cases of relapsing fever consists of ten drops of phosphoric acid. This may be given as a dose in water, plain or sweetened, every two hours.

If the head symptoms and delirium are particularly troublesome, a combination of bromide of potash and chloral may be administered; three drachms of bromide of potash and two drachms of chloral may be dissolved in six ounces of water. The dose is a tablespoonful every two hours in the case of an adult.

Its Epidemic nature.—It may be added that this disease appears to be of epidemic nature, one fact in proof of this opinion being found that it appears to spread along lines of human communication, being conveyed in this case by the sick to the healthy. Its germs would also appear to be conveyed by the clothing of patients. Hence it is necessary that disinfection should be used in connection with the prevention of this disease.

MEASLES

Measles is a disease belonging to that class of infectious troubles which is characterised by the development of a distinct rash on the skin. Such ailments are termed *exanthemata*. Included in this group we naturally find small-pox, scarlet fever, and also typhoid and typhus fevers. An important point in connection with measles, and one which also concerns *whooping-cough*, is found in the observation that of late years both diseases, formerly regarded as comparatively trivial and unimportant, appear to have largely increased in respect of the mortality they cause. Mothers should receive this statement, therefore, with interest, the lesson taught being that of regarding both measles and whooping-cough as diseases by no means to be neglected or treated as trivial ailments. Whether this increase in danger is due to some alteration in respect of the virulence of the germs of these ailments, or whether it implies some change in the human constitution rendering it more liable to attack is an open question. The result just mentioned, however, should suffice, apart from its causes, to place us on our guard when dealing with either trouble.

Its History.—The germ or microbe of measles is still unknown. It is a highly infectious fever. In the seventeenth century the differences between scarlet fever, measles, and small-pox were clearly

made out. A consideration worth noting regarding measles, as well as other diseases liable to affect us in early life, is that which teaches us that with advance from childhood towards youth the risk of attack decreases. Hence we may very well combat the common notion entertained by mothers that it is necessary for children invariably to pass through the whole round of such ailments. Such an opinion, if carried out into practice, would largely handicap all efforts directed towards the abolition of such ailments. If people come to regard them as inevitable, it is clear they will take no trouble in the way of prevention.

A highly pernicious practice often illustrated amongst the masses is that of actually infecting sound children by allowing them to sleep with one that has become infected in a family. This practice is attempted to be justified on the ground already mentioned, that it is more convenient to have the disease over and done with at once in a family, than to have subsequent and successive attacks in the case of each of its members. There can be no justification for any such practice, on the ground that it is an absolutely criminal procedure to convey disorder of any kind from those who are sick to those who are healthy, thereby entailing a risk of severe illness and also of death. The practice in question should be severely condemned by every right thinking person.

Period of Attack.—In so far as the curve of measles-development is represented for an enormous centre of population like London, we find this curve to rise in December and in June. It sinks low in February and September. We also know that the death-rate from measles is greatest in the second year, but it decreases for every successive year of life. Indeed, it is said that 60 per cent. of the deaths occur during the first two years. Measles appears to be a disease more dangerous to female children than to males, having regard to females attacked above the age of five years.

It is notable that when a disease like measles, relatively simple in the case of a civilised nation, attacks an uncivilised one, the mortality may be very great. Measles practically decimated the Fiji Islands in 1874. We may suppose in this case that susceptibility to measles attack on the part of the civilised race has had the effect of modifying the body so as to render the action of its germs less virulent than in the case of bodies which have not acquired a certain degree of immunity by reason of long experience of the disease. Epidemics of this disease are extremely common, but it is notable that the intervals between them are of short duration, probably two or three years being the outside limit.

In the case of epidemics of scarlet fever it is found that odd cases

may remain after the great wave of an epidemic has passed away. In the case of measles, however, it is found that when the epidemic ceases such odd cases are rare. This disease evidently spreads very largely along lines of human communication, for it is found that islands removed from mainlands may escape for lengthened periods. In their case, infection, once introduced, runs its usual epidemic course.

Infection.—Infection in this disease is no doubt communicated by the secretions of the nose, mouth, and by the breathing of infected air. It may also be carried by clothing, and has been known apparently to be conveyed, probably in this latter fashion, by persons who have been in contact with cases of the disease. Water and milk appear to have no connection with its origin ; and soil, such a powerful influence in typhoid fever, may be left out of account in the case of measles. An interesting feature is that of noting that epidemics of measles are often accompanied by outbreaks of whooping-cough, although any exact or real connection between the two has not been demonstrated to exist.

Incubation and Symptoms.—This disease appears to have a period of incubation of from seven to eight days, but this period has been extended to from ten to fourteen days. The characteristic *symptoms of measles* are found in the fact that all the signs of a severe cold in the head appear, associated with sneezing, headache, and digestive disturbance, the tongue usually being much coated. The temperature rises rapidly, but may fall on the second day of the fever. The rash appears about the fourth day, when the temperature again rises and may attain a height of 104 degrees Fahr. The rash lasts for three days. Its first appearance takes place at the roots of the hair on the forehead and on the face. Later on it spreads to the body at large. The eruption here has the appearance of raised spots, dark red in colour, with a tendency to run together, forming crescent-like patches, which are smooth to the touch. There is also considerable swelling of the skin, giving to the patient a somewhat dropsical appearance. In three days after its appearance the eruption fades, and will be noticed to disappear first from the face. Its relics are seen in the shape of stains of a reddish-brown appearance, which may at a later stage scale off, this latter feature being specially noticed in the face. When the rash fades the temperature falls, and the other features of the disease in due time become modified.

An important point in considering this disease is that of noting that, whilst a simple case runs the course just described, the fever may also exhibit a form in which there may be no symptoms of cold in the head, and even the eruption may be absent. There exists

another variety of the ailment, known popularly as *black measles.* This name has been applied to such cases from the fact that bleeding is apt to occur in the case of the disease. Thus we may find bleeding spots under the skin appearing as dark-coloured areas, whilst bleeding from the nose and other parts is not uncommon. This latter species of measles is of a more serious character than the first, and is also apt more definitely to be associated with complications of the disorder. These complications include lung troubles, chiefly of the nature of bronchitis, or inflammation of the lungs. Occasionally symptoms of croup are also associated with this ailment. The eyes are also apt to exhibit a very severe form of inflammation, whilst the glands in the neck may become enlarged. A very common sequel of this fever, as well as of scarlet fever, is found in ear troubles, which result in the discharging of matter from the ear, associated with destruction of the ear-drum, and tending to the production of deafness, if this condition is not early and properly attended to. Dropsy, with albumen in the urine, is also found in measles, especially after a relapse due to chill.

Treatment.—In the *treatment* of this disease the general principles already described as proper to the treatment of all fevers is pursued. A very important point here is the guarding of the patient from cold and chill. He should be treated in a darkened room. The diet will be largely milk, and the state of the bowels should be carefully regulated. In the case of any lung symptoms appearing, the attention of the physician will be at once directed towards care in this respect.

By way of increasing the action of the skin it is usual to prescribe some simple mixture. A formula useful in most feverish affections in children is made as follows: Ipecacuanha wine, one drachm and a half; compound tincture of camphor, three drachms; liquor of the citrate of ammonia, half an ounce; syrup, half an ounce; and water up to two ounces. The dose will be a teaspoonful every two hours.

Physicians are accustomed to give patients a mustard bath by way of stimulating the action of the skin, if the rash at any time does not fully develop. This bath should be used for a few minutes only. For an unusually high temperature ten grains of phenacetin may be used in the treatment of this disease. The dose would be from one quarter to half a grain of this substance, given every two hours, for children over two and up to ten or twelve years of age.

The chest will require to be poulticed if lung troubles appear, and each ailment which may develop in the course of this trouble must be of course separately treated. Special reference under this head

may be again made to the absolute necessity, by way of avoiding serious consequences, for attending at once to any ear discharge which may appear. The child in such a case should be treated by an ear surgeon if the drum of the ear is to be saved from destruction.

Some physicians recommend the application of cold cream to the face and carbolated oil to the body at large, by way of relieving any irritation caused by the eruption. After recovery the child's general health must be carefully attended to. Cod liver oil or Virol should be given after meals, whilst tonics may be required. Great care must be taken against exposure to cold, and a change of air is a highly important factor in inducing an early return to a state of complete health.

GERMAN MEASLES

This disease is also known under the names of *Rubella*, *Rubeola*, and *Rötheln*. It would appear in some respects to present a half-way house, so to speak, between scarlet fever and measles. It is, however, not to be regarded as a combination of the two. Its greater resemblance is towards measles. It is an infectious disease, but the contagion does not appear to be disseminated with the freedom and quickness seen either in scarlet fever or measles. The chief source of infection would appear to be the breath.

The period of incubation in this disease seems to extend to about a fortnight. The attack or manifestation of the fever itself is usually of a sudden character. The rash appears in a day or two after the feverish symptoms manifest themselves, and appears first in the face, gradually spreading over the body. The spots are of a bright red colour. They are fairly prominent above the skin, and usually run together, forming patches. The rash only persists for twenty-four or forty-eight hours. It fades away without leaving any skin discoloration. A second attack of this disease is not usual, and in this respect the disease resembles measles.

This trouble is also characterised by the want of a high rise of temperature, so that fever is not a marked symptom of the trouble.

Treatment.—The only danger to be apprehended here is that of some lung complication, which is chiefly to be found in the shape of bronchitis. No special treatment other than that applicable to measles is necessary here. The patient must be confined to bed, although the period of his confinement may be found to be extremely short.

If throat troubles appear they may be treated by any ordinary gargle. Such a gargle may be made by adding sixty grains of tannic

acid to six ounces of camphor water. A little of this diluted with water may be used as often as required. As in the case of measles, it will be well that the after-nourishment should be thoroughly attended to, along with a period of country or seaside residence for a time, the resort chosen to be of a mild climatic nature.

WHOOPING-COUGH

This disease is named by physicians *Pertussis*. As is the case with most of the ailments we are considering, one attack seems to protect the body against subsequent invasion. This ailment is extremely infectious, and is often associated with epidemics of measles, as has already been remarked. It becomes epidemic every two or three years. As in the case of measles, water and food and milk do not appear to have any influence in conveying the disease, the germ of which has not been discovered. Insanitary conditions undoubtedly affect the onset of whooping-cough, hence the beginnings of an epidemic are very frequently to be found amidst the poor and overcrowded places, and amongst ill-nourished children.

Infection, &c.—The source of infection is no doubt largely the breath, but it may be said that the secretions of the nose and the mouth are to be regarded with suspicion. That infection is borne by the air seems extremely probable, seeing that an epidemic is rapidly spread where one or two cases have occurred. The *incubation* stage of this disease may be set down at about a fortnight, but some authorities state that this period averages less than a week. The disease sets in with symptoms of a cold. There is not much fever witnessed in this preliminary stage, and the cold itself may last for three days or longer.

Symptoms.—The characteristic feature of the disease is, of course, found in the peculiar *whoop* or short harsh cough from which the disease derives its name. This cough is peculiar in its nature. The child exhibits a series of short gasps or expirations rapidly succeeding one another, so that it seems to have exhausted all the air in its lungs. Then we find a long, deep breath taken, succeeded by the "whoop," when relief is obtained. Previous to this the face of the child is deeply flushed, and it appears to be in danger of suffocation. The crowing, or "whoop," relieves the distress. This process may be repeated more than once, and some mucus may be brought up from the lungs as the result, whilst vomiting not infrequently happens as the result of the paroxysms. The "whoop"

appears to be caused by the air attempting to enter the windpipe when the aperture of that tube is contracted in a kind of spasm. It is the termination of this contraction which relieves the paroxysm. These symptoms are usually most marked at night. Any matter brought up from the lungs tends to become thinner and more easily expelled as the disease progresses. When recovery begins, the whoops decrease in number, but the period of convalescence is apt to be extremely long. Dangerous complications to be feared here are those affecting the lungs, whilst the heart may suffer somewhat from the strain and violence of the cough. Naturally, in the case of a weak child, the disease is to be regarded as much more serious than when it affects a healthy subject.

The Cause.—It is highly difficult to account for the peculiar symptoms this disease exhibits. One opinion refers it to some disordered action on the part of the nerve centres governing the breathing movements. If the disease is to be regarded as caused by a microbe, which may be probable enough, it may then be regarded as being due to the action of the particular poison or toxin produced by these germs affecting the nervous centres above named.

Treatment.—The treatment of this disease is unsatisfactory, in the sense that there appears to be no special drug capable of arresting the paroxysms. A large number of drugs known as *anti-spasmodics* have been tried. These substances tend to counteract spasms at large. Antipyrin has been well spoken of as tending to limit the paroxysms. The dose here would be one grain for each year represented in the child's age, and such a dose would be given every six or eight hours. This remedy is a favourite with many physicians, because of its apparent power of allaying the spasms. Another drug which has been used in the treatment of whooping-cough is belladonna. What is known as "Fuller's Mixture" is composed of eight grains of sulphate of zinc, seven grains of extract of belladonna, and four ounces of water. A teaspoonful would be given four times a day to a young child, whilst an additional dose might be given each day in the case of children over the age of four years. Chloral has also been much used in the treatment of whooping-cough. The dose here is one grain for each year of life, and this amount may be given in water twice or thrice in the twenty-four hours, according to the frequency of the spasms. Oxalate of cerium, in a dose of two or three grains given twice daily, has also been recommended for children in this trouble. The liquid extract of ergot, given to the extent of one drachm per day, this amount being divided into three or four doses, has been found to affect the spasm in some cases.

Inhalations, &c.—*Inhalations* have also been tried in the treatment of whooping-cough. Carbolic acid vapour has been frequently used. A simple method of impregnating the air of a room with the vapour of this substance, being that of dropping a little of the pure acid on a heated plate. This process for a time will suffice to give off vapour enough for the purpose intended. The throat may also be *sprayed* with certain lotions. Thus a spray composed of four grains of carbolic acid, sixty minims of glycerine, and ten grains of carbonate of soda dissolved in one ounce of hot water is frequently employed. This mixture should be placed in a spray-producing apparatus, and the back of the throat sprayed twice or thrice daily. It is added, however, that the urine should be watched during the progress of this treatment, so that if it appears dark in colour and of a smoky appearance, the inhalations should be given up; this latter appearance showing that the carbolic acid has been absorbed by the blood.

Embrocations applied to the body have also been tried. Roche's embrocation is a favourite popular remedy in this disease, but friction may be made on the back and chest with any ordinary liniment; whilst some physicians have recommended that a poultice containing mustard should be used along the course of the spine at night for a short time, so as to cause a certain amount of redness of the skin.

The *diet* in this disease will represent the usual light food proper to all fevers. There can be no objection to giving the patient a little fowl, fish, or meat. As in other cases, convalescence will be aided by a change of air.

Popular Cures.—In connection with the treatment of whooping-cough, a curious custom has long been in vogue amongst a certain section of the people. Thus it is no uncommon thing to find mothers taking their children to gasworks, where the tar tank is opened and the child is made to breathe the vapour which ascends therefrom. In other cases children have actually been taken down a coal-mine, by way, presumably, of affecting them through the special atmosphere which may be supposed to be there prevalent. It may be that the first of these methods is founded upon some reasonable basis, seeing that tar vapour may contain substances some of which may possess an influence on the disease. The experiment of the coal-mine is, on the other hand, rather more doubtful, because in modern times the ventilation of mines brings the air therein very nearly, if not quite, up to the standard of the ordinary atmosphere outside.

INFLUENZA

Influenza is an ailment which has come markedly into prominence of late years. It is a disease which has apparently long been known, although its more active manifestations have only formed a marked feature of recent years, in Britain at least. Medical historians tell us that influenza is of extreme antiquity, and that no fewer than forty-five epidemics of this trouble occurred between the sixteenth and eighteenth centuries. The disease appeared largely to die out about the year 1848; but in 1889 it reappeared in Russia, and became pandemic, being largely represented both in the Old and the New World. It was probably this renewed origin of the disease in St. Petersburg which gave to the ailment the name of "Russian influenza." With reference to its spread and other characteristics, influenza would appear to present certain distinct peculiarities. Ordinarily speaking, by "influenza" was meant to be indicated an ordinary severe type of cold, accompanied by shivering, headache, and rise of temperature. These symptoms rapidly passed off, leaving no ill effects behind. Influenza is of course to-day a very different disease, as we shall presently note. It not merely runs a definite course, but also presents us with certain very important variations from the case of an ordinary cold.

Influenza Conditions.—Nowhere in the world is influenza an endemic disease. It has practically no settled or fixed habitation or home. It springs into existence through the rapid development of its germs, this development depending upon causes which as yet have been imperfectly ascertained, but it would appear to be associated more especially with conditions of dirt and overcrowding; although, in so far as its spread is concerned, these conditions are not necessarily represented, for the disease attacks persons in all stations of life, whether surrounded by insanitary or by healthy environments. The *season* does not appear to exercise the slightest influence upon this disease. It is as common in hot countries as in cold; it may attack persons of any age, and both sexes seem equally liable to invasion. A highly important consideration connected with the history of influenza is that which shows us that *certain lower animals* are apt to suffer from it. Horses, dogs, and cats may be attacked, and a notable feature has been observed in the fact that it generally appears in lower animals before it attacks man. It may thus prove to be a disease which man owes to his association with his lower neighbours. In the horse the disease has received the name of *pink-eye*, a term applied from one of its symptoms, severe inflammation

of the organ of sight. An epidemic of "pink-eye" has been noted in this country in the horse, prior to the establishment of influenza as a human trouble.

Infection.—There can be no doubt that infection is air-borne, but it is also recognised that association with infected individuals will convey the disease, a point illustrated by the spread of influenza through a household. With reference to this spread, like cholera, it follows the track of man, although it may also exhibit certain very curious features in its distribution. Thus ships' crews have been attacked by this disease without having had any communication with the shore, such an occurrence tending to suggest the air-borne nature of the infection. So also, one town may be severely attacked, whilst a neighbouring town may largely or altogether escape. It is generally admitted that the germ of influenza has been isolated. This is a very minute bacillus, long in proportion to its breadth, and found very frequently existing in clumps or masses. It does not appear to be a germ of extreme vitality, seeing that under cultivation it does not live for any lengthened period. The microbe is found in the blood of influenza patients, and has likewise been seen in the discharges from their lungs.

Incubation and Symptoms.—The period of incubation must be of extremely short duration, the maximum period being set down at three days. There is a sudden onset of the symptoms. The chief of these are, a rise of temperature accompanied by shiverings, a rapid pulse, severe headache, pain in the small of the back, and also in the calves and back of the knees, attended by a considerable amount of muscular weakness and inability to move freely. A characteristic hacking cough frequently accompanies this disease in its early stages, and in later stages as well. The usual *duration* of an attack is about three days. It does not terminate in profuse sweating, but its departure is marked by a gradual disappearance of the symptoms, leaving a patient in an extremely weak and exhausted condition.

Complications.—An interesting feature of this disease, and one of much practical importance as regards its care, is found in the fact that *complications* are extremely liable to follow an attack. It is these complications, in fact, which probably constitute this disease a dangerous one. Physicians recognise that at least four lines of attack are represented in this phase of its history. In the first set of cases, the *nervous system* is essentially affected, and instances are known where absolute mental breakdown has resulted from an influenza attack. In the second class of cases the *heart* appears to be the organ specially affected, and various forms of heart-weakness have

been found to result. In the third variety of complications the *lungs* are liable to be affected; whilst we may add a fourth variety in which the *digestive system* appears liable to suffer in various ways. Also certain *skin troubles* have been noticed to follow upon an attack of this disease.

These facts would appear to indicate to us that the *toxin* or poison which the germs of this disease produce in the body, not content, as it were, with inducing the ordinary symptoms of the disease, have the habit of selecting what may be termed the "weak point" of the individual for their subsequent attentions; so that in the treatment of influenza, it is a matter of the highest importance for us to recognise that if any special bodily weakness is known to exist, that condition should receive earnest attention in the way of care and treatment. It is further stated as the result of experience of this disease, that when it appears in an epidemic form other ailments of infectious character are apt to increase, and the death-rate from the latter also in its turn exhibits a rise.

Treatment.—There can be no doubt in the *treatment* of influenza the one great safety for the patient is at once to seek relief in bed. Medical experience has shown that the most serious cases of this trouble are those in which the patient has attempted to fight his trouble. Hence "early to bed" should be the motto carefully observed whenever an attack is experienced. It is recommended that at the outset a warm bath or a foot bath should be taken. The *diet* is to be of non-stimulating character; indeed the state of the appetite will preclude the possibility of the patient demanding any other kind of food.

Drugs.—A large variety of drugs has been used in connection with influenza treatment. Thus quinine has had its admirers, on the ground that influenza being related to diseases of malarial type (such as ague, &c.), quinine may be regarded as likely to favourably influence its course. It has been administered in a dose of three grains twice or thrice daily. It is usual to give this remedy in a little sherry wine. Amongst other drugs which have been used *salicylate of soda* may be mentioned, whilst *salicin* has also been used. Salicylate of soda should be given in fairly large doses, very much as already described in the treatment for *rheumatism*. Of salicin itself, some physicians speak very highly. This drug may be given four or five times daily in a dose varying from twenty to thirty grains.

Such drugs as phenacetin and antipyrin have also been used for the treatment of influenza. If they act favourably at all, it will be on account of their sedative effects, and by reason of their temperature-reducing properties. A preparation which has been used

with much benefit in influenza cases is *salophen.* This drug may be given in doses of from ten to fifteen grains twice or thrice daily.

Where there is any complication of the heart-order suspected, special attention must be paid to this feature. A medicine much used in this connection is citrate of caffein, the dose being five grains given twice or thrice daily. *Skin action* is sometimes necessary to be favoured by way of reducing the fever. A simple mixture adapted to secure this result is made of spirits of nitre, twenty drops; solution of the acetate of ammonia, two drachms; syrup of lemon, half a drachm; and water, one ounce. These quantities constitute *one dose* of the mixture, and this dose may be taken every four hours. When there is much depression with slowness of the pulse, the following has been recommended: Carbonate of ammonia, four drachms; tincture of cinchona, an ounce and a half; aromatic spirits of ammonia, four drachms; and decoction of cinchona, up to twelve ounces. One or two tablespoonfuls may be given in effervescing water to which a little syrup of lemon has been added, every four hours.

Food.—Influenza is not a disease in which a depressing diet should be given. Acting on this rule the food, as already stated, should be nourishing, without being of an unduly stimulating character. It may be necessary to prescribe *alcohol* in one form or another for the relief of prostration. Champagne or brandy will be found in all probability the safest form in which alcohol may be prescribed. Convalescence after influenza, as has already been noted, may be a long and tedious affair. *Tonics* are necessitated here with change of air, and a sea voyage or residence by the sea will be found to suit a large number of convalescent cases. Such sundry after-effects as may attend an attack of this disease must be treated each according to its special nature. A general tonic adapted for a large number of cases by way of a bracing nature is that known as the compound syrup of hypophosphates. This may be given in a teaspoonful dose thrice daily in water, either half-an-hour before meals or just after meals, as the patient may find most beneficial. *Easton's syrup*, an allied preparation, is also largely prescribed as a general tonic. It is of a powerful nature, the dose being a small teaspoonful thrice daily after food in water.

CEREBRO-SPINAL FEVER

The history of this disease is a somewhat peculiar one. It would appear to be specially connected with some condition affecting the *brain* and *spinal cord;* hence it is also known as *epidemic menin-*

gitis. Abroad, and in Ireland, it has occurred in epidemic form, and has been found associated with typhoid fever and other ailments. On the Continent and in America it has long been recognised. This peculiar disease does not appear to be directly infectious. Hence it would seem that its poison or germ, like that of typhoid fever, is probably transferred independently to those who suffer from it from some common source. In some cases it has specially attacked children, and with regard to its surroundings, dirt and poverty, with bad ventilation, appear to markedly affect its invasion. It was noticed in 1846 in Ireland and also in 1848, when it was attended by a high mortality. In the Irish epidemic the inmates of workhouses were specially affected.

Symptoms.—This disease appears to have a sudden invasion or onset manifested by shivering, giddiness, headache, vomiting, and even delirium, The face is usually pale, the eyes red and congested, whilst their pupils are contracted. There is seen a peculiar and painful contraction of the muscles of the neck throwing the head backwards. The skin is so sensitive that, on the slightest touch, the patient may cry out. Along the course of the spine such sensitiveness is very marked. Later on *convulsions* may occur, and the patient may succumb from symptoms resembling those of *lock-jaw.*

Eruption and Course.—A rash is found in this disease, which attacks males more frequently than females. This rash appears on the second day of the fever, and is seen in the form of dark spots, probably due to the effusion of blood under the skin. It appears on the neck and front aspects of the limbs, and also on the breast. The spots are rarely seen on the face. This disease runs an extremely rapid course, and may prove fatal in a few hours, whilst such a result may be prolonged after twelve or twenty-four hours have elapsed. If the patient survives for three or four days, his recovery may be a very likely event.

Treatment.—In the *treatment* of this ailment physicians have been accustomed to give stimulants in fair quantity. *Leeches* may be applied behind the ears, whilst ice bags applied to the spine and head also tend to give relief. The drugs which have been most frequently relied on are chloral and bromide of potash. Such a mixture as is represented by three drachms of bromide of potash and two drachms of chloral dissolved in six ounces of water may prove useful, the dose being a tablespoonful given every two hours.

For the convulsions chloroform is generally given in the shape of inhalation. Quinine has also been administered, and one authority speaks highly of the use of calomel as a purge. It may be added that the Irish epidemics were popularly known as the "*black sickness.*"

SCARLET FEVER

Scarlet fever (otherwise known as *scarlatina*) is a disease which has been long known to medicine. Its record, as far as European medicine is concerned, goes back some five hundred years. In former days it was confused more or less materially with *diphtheria*, and probably this confusion arose from the fact that epidemics of scarlet fever are often accompanied by cases or manifestations of diphtheria. The two diseases, in so far as modern opinion is concerned, however, appear to be essentially distinct. Scarlet fever is generally esteemed to be a disease peculiar to temperate climates. In Britain it appears to be more prevalent in centres of population than in country districts. Considering that the microbe of this fever (which by the way has not been satisfactorily isolated) appears to be capable of ready transmission from individual to individual, and also that infection can be conveyed by the air, as well as by articles of clothing and other objects, we can readily understand the *highly infectious nature of this ailment*.

Infection.—It is notable that the disease appears to be infectious from the first, and a point worthy of remembrance also is that which reminds us that *the germs of this disease may retain their powers of infection for very long periods*, lying thus in a dormant condition, but also exhibiting the power or tendency of waking up into vitality when favourable conditions are presented. Thus the toys played with by a child suffering from scarlet fever, and preserved after the death of the patient by the mother, have been known to convey infection when, after a period of years, these toys have been presented to and used by other children. This fever is also known to be conveyed through the medium of *letters* written by patients, especially during the stage of convalescence. The mode of conveyance of infection in such a case presents no great difficulty of explanation. In this fever convalescence is marked by the *peeling* or *desquamation* of the skin, and authorities agree that in the microscopic skin-scales thus given off, the germs of the ailment are contained. It is of course an easy matter for such a source of infection to be represented when the skin-scales of the patient comes in contact with external objects. Hence many physicians practice inunction with oily substances on the body of a recovering patient, by way of preventing the dry scurfy particles of the skin from escaping into the air. The bedclothes of patients and the clothes of persons in contact with patients must also be regarded as means of infection. No definite relation between the state of the soil and scarlet fever is known to exist, nor does it appear that water

is capable of acting as a medium of infection, but there can be little doubt that *infected milk* is responsible for the lighting up of many epidemics. In the latter case it is generally found that some employé of the dairy or dairy farm has suffered from this disease, or has at least presented symptoms of suspicious sore throat.

Slight Cases.—It may be added here that one of the difficulties of dealing effectively with this disease is the fact that many slight cases occur where the symptoms are more or less masked. In such cases, the eruption may be very faint and indistinct, the sore throat symptom may be in abeyance, and the peeling of the skin may only be detected by a scurfy appearance between the fingers and in other parts of the body. Yet such cases, mild as they appear to be, have the power of conveying infection, and when the infective particles have been transferred to other bodies, the mildness of the infecting source is by no means necessarily represented in the case of those who are attacked. Altogether scarlet fever may be regarded as a somewhat insidious disease with reference to infection. As far as regards patients themselves, infection is given off not merely by the secretions of the mouth, nose, and throat, but as has already been indicated during the process of skin-peeling. Physicians believe that infection is less likely to occur at the end of the first week than during the fever stage or after skin-peeling has proceeded.

The Microbes.—It has been remarked that the germ of scarlet fever is at present unknown, yet it is proper to state that a *micrococcus* has been isolated from patients suffering from the ailment. This micrococcus (a name indicating a germ of rounded shape) when inoculated into cats, appears to produce an ailment which corresponds to scarlet fever in man. Bacteriologists have isolated from scarlet fever patients, and from cultivations of the germs found in their secretions, other microbes, one of these being a *bacillus* or germ of rod-like shape. Notwithstanding these researches, the problem of the exact source of this fever may be regarded as still undecided. The difficulty here would appear to exist in the fact that a number of germs may be isolated from scarlet fever secretions, and it is a matter of considerable difficulty to determine which of these (or whether more than one of these) may be regarded as the true source of infection. The case of scarlet fever in this respect may be regarded as parallel to that of diphtheria. The germ of diphtheria has been accurately described, but associated with it are microbes which exhibit marked differences from the true bacillus of the disease itself. The exact relations between the true and false bacilli is not definitely known. Some observers have gone the length of stating their belief that the so-called pseudo-bacilli of diphtheria are necessary for the full

development of the actual disease-producing germs. It may be so also in scarlet fever where a multiplicity of microbes has to be dealt with. It seems, therefore, in the present state of our knowledge better to assume that the definite microbe of scarlet fever still remains to be discovered. This expression of opinion implies no doubt whatever that the disease is a germ-produced one. One attack of this disease, as is usual with other fevers of like nature, usually protects against another.

The Rash and Symptoms.—Its name is derived from the fact that the rash is of scarlet colour. The period of incubation as a rule extends to three or four days only, but it may be extended to seven days; on the other hand, it may be short and sharp, so to speak, the first symptoms of the fever appearing within twenty-four hours of infection. On this account the fever is regarded as an essentially active one, so far as its powers of infection are concerned, and the health-lesson which is taught us by these observations is that of regarding a case which has been exposed to infection as in its turn practically liable to convey the disease from the time when the body begins to develop the ailment.

With reference to the *preliminary symptoms* of the disease, we find these to consist in soreness of the throat, headache, and pains which may extend throughout the body. Of these symptoms, those manifested in the throat soon increase in severity. In the neck is experienced a feeling of stiffness, and the glands there become painful and swollen. On the second day of the fever the rash appears—in some cases even earlier. Its first appearance is on the neck and upper part of the chest. Then succeeds a rapid spread over the face and body at large. The *throat symptoms* will, as a rule, continue to become of marked character. The *tonsils* particularly are swollen, and exhibit specks of yellowish hue, indicating inflammation of the structure of these glands. Very frequently on the tonsils of patients suppurating points may occur which, running together, give in some degree the appearance of the throat noticed in the case of diphtheria. In an ordinary case of scarlet fever the eruption fades away about the fifth day, and the peeling or desquamation of the skin may begin as early as the day afterwards. This process of skin-peeling may take place, as has already been indicated, in the shape of the giving off of mere branny-like scales. In other cases large portions of the skin desquamate, even to the extent of the skin of the hand peeling off very much after the fashion of a glove. This period of skin-peeling will last from four to eight weeks, *therefore during that period the patient is liable to infect others.*

The Tongue.—The tongue in scarlet fever exhibits a highly characteristic appearance, which doctors and nurses are accustomed to note. In the first instance it develops a white fur, but later on the fur disappears, and redness of the tongue is developed, while, through this redness the swollen *papillæ* or projections of the tongue being clearly seen, the organ exhibits what is known as a "strawberry" appearance.

Other Varieties of the Fever.—In the more acute form of scarlet fever, known as *scarlatina anginosa*, the temperature attains a higher level than in the ordinary simple attack just described. Physicians have noted that in this form of the ailment the temperature may rise to 108 degrees or even higher. In such a case the eruption is apt to appear later than in the simple variety of the fever, and instead of being red in colour exhibits a purple appearance, whilst the throat trouble attains a higher degree of virulence. The third and worst variety of scarlet fever is *scarlatina maligna.* Here, in addition to all the other symptoms being more distinctly marked, brain symptoms appear, with vomiting. The general tendency of this latter form of disease is apparently to develop a marked change in the affected tissues. Especially are the throat and mouth parts affected. The inflammation in such a case proceeds towards ulceration, giving rise to destruction of tissue and to a most offensive odour as a consequence thereof. This latter variety of the disease is of course the most serious of all.

Complications.—Scarlet fever is an ailment which in the mind of a physician is essentially associated with dangers arising from its complications. These complications, unfortunately, are many. Thus *ear affections*, similar to those which have been recorded in the case of measles, are singularly liable to occur, involving suppuration of the middle ear with ear-discharge and a probable destruction of the ear drum and consequent deafness. The *glands of the neck* may be involved as the result of the throat inflammation and may even proceed to the length of suppuration. Especially are the *kidneys* liable to be affected in the way of development of a special type of inflammation. When the kidneys are thus affected the urine becomes high-coloured or of smoky character. *Albumen* is found to be present in the urine, whilst there may be found dropsy exhibited in the body, especially in the eyelids and ankles, or more generally in the body at large. It would appear in this case that the poison generated in the blood by the germs of the ailment exerts a special influence on the kidney, and there can be little doubt that where *cold or chill* has been sustained by the patient, even during the process of recovery, the tendency to develop kidney troubles will be apt to be highly aggravated.

Treatment.—With reference to the treatment of scarlet fever there can be little doubt that the ordinary mode of dealing with fever is here illustrated. It will be important first of all to see that the bowels are made freely to move by means of an ordinary saline purge. The *diet* will consist largely of milk, and in order to secure action of the skin it may be well to give a mixture calculated to secure free perspiration. Such a mixture is represented by the following: Liquor of the acetate of ammonia, half an ounce; spirits of nitrous ether, three drachms; tincture of hyoscyamus, three drachms; and camphor water up to six ounces. The dose of this will be a tablespoonful given every two hours. For the *throat symptoms* it is necessary to use either some form of gargle, or to swab the throat with some lotion. A solution of chlorate of potash, one part to ten of water, may be used as a gargle. A chlorate of potash lozenge allowed to dissolve in the mouth will frequently give ease when the throat trouble appears to be of marked intensity. Ice allowed to dissolve in the mouth may give a certain amount of relief, besides tending to assuage the thirst. The throat should be covered with cotton-wool. Most physicians recommend in this disease that the whole body should be sponged with tepid water twice a day, whilst after the bath some form of oily application, such as carbolated oil, or vaseline, or cold cream, may be applied to the skin. In mild cases a warm bath may be used. In some forms of practice injections of cold water by the bowel have been found to reduce the temperature. To the water used for sponging the body a little aromatic vinegar may be added. In one mode of practice, in order that the peeling of the skin may be prevented from disseminating the germs of this disease, it is advised that carbolated oil of a strength of one to forty should be applied to the skin during the progress of the ailment.

Head Symptoms.—In the case of any *delirium* or severe *head symptoms* an ice-bag should be applied to the head, and in such cases it is well that the scalp should be shaved. Iced water applied on lint to the throat may also afford great relief to the symptoms manifested in this region. For the pain and swelling in the neck and jaws leeching may be practised, two or three leeches being applied on each side. This latter practice, however, is not approved of in the case of children, in whom hot applications are preferable. A weak carbolic solution may be sprayed into the throat in the case of children. Such a mixture as the following may be found useful in this connection either as a spray or as a gargle: Glycerine of boracic acid, four drachms; glycerine of carbolic acid, two drachms; rose water, ten ounces. A little of such a spray or gargle may be used two or

three times daily. If used as a gargle, a small amount should be diluted for each application with an equal part of water.

The Malignant Type.—In the case of *malignant scarlet fever* greater care is necessary in the case of the patient, and as in such a case home treatment is apt to prove unsatisfactory, the attention and care of the physician is absolutely necessary. One rule of treatment in the latter case is to administer *alcoholic stimulants.* Probably the best form of such agents will be port wine, whilst by way of further stimulating the skin to action, each day a hot bath in which mustard has been dissolved has been recommended.

By way of reducing the temperature in scarlet fever at large, phenacetin has been highly recommended for children between the ages of two and twelve. This may be given when the temperature is high in a dose from one quarter to half a grain every two hours.

Precautions against Infection.—Precautions are necessary to be taken in the case of this disease for a prevention of the spread of infection from the patient to other members of the household. Without encroaching upon the information to be given in this work under the head of *Infection* and *Disinfection*, where the subject will be fully treated, it may here be noted that if a scarlet fever patient is to be treated at home he should be placed in a room as high up in the house as possible. From that room carpets, curtains, and all articles of furniture not required for the comfort of the patient should be removed. The room must be well ventilated, and the presence of a fire will aid the diffusion of air through the apartment. It is usual in such a case to prevent the escape of germs from the patient's room by placing a sheet outside the door. This sheet should be kept perpetually moistened with a disinfectant solution. An example of a convenient solution is made by dissolving one part of Izal in two hundred parts of water, the nurse keeping the sheet perpetually moist. An ingenious contrivance to effect this end is that of placing on the top of the door a narrow zinc receptacle which is filled with the disinfectant solution. The upper end of the sheet is pulled through a slit in the bottom of the zinc box, and the solution trickles downwards through the sheet in virtue of capillary attraction, thus rendering it perpetually moist.

It need hardly be said that all communication between the patient's room and the rest of the house must be prohibited. The nurse will see that all rags used to wipe the patient's mouth are instantly burned, and all spoons or cups or other vessels used by the patient are not to be allowed to pass out of the room, but must be cleansed within the room, thus preventing any possibility of conveying the disease to other members of the household.

Hospital Treatment.—In connection with this subject it should be added that the typical treatment, not merely of scarlet fever patients, but of patients suffering from infectious diseases at large, is that of instantly conveying them to a properly regulated fever hospital. The time will assuredly come, through the education of the public in health matters, when no case of infectious disease will be treated in a private house. If this practice were universally carried out, the amount of infection liable to occur—especially in the case of the working-classes, who do not possess means adequate for the proper segregation of their patients—would be materially diminished, and a chance at last obtained of the abolition of infectious diseases at large.

Convalescence.—Convalescence from this disease, as a rule, is apt to prove somewhat lengthy. The rule should be noted that no sufferer from scarlet fever should be regarded as free from chances of conveying infection *until at least six weeks* from the date of his being seized with the fever. In cases in which there has been delayed convalescence, it will be well to add one month to this interval. As in the case of diphtheria, attention should be paid to the throat of patients after recovery, and it might be well if some time after recovery the throat should be gargled regularly with a solution of boracic acid, or with a solution of permanganate of potash and water. A few crystals of this latter substance itself, dissolved in half a tumbler of tepid water so as to make the solution of a claret colour, will be found useful for the purpose indicated.

Some other details.—Some additional points connected with the history of scarlet fever are worth mentioning by way of close to these remarks. It would appear that this disease as regards its liability to infection attains its highest point about the fifth year of life. After this age risk of attack appears to decrease year by year. Mothers should take this lesson to heart, because if infection be guarded against during the earlier years of the child's life up to the fifth, he is less likely to be attacked, and furthermore should infection appear after this period the chances of a mild attack, and therefore of complete recovery, are proportionately increased. We have seen in the section dealing with the *seasonal development of disease* that scarlet fever attains the highest development in October, and its lowest in March and April. In New York, however, the highest development appears in April and the lowest in September. It may be also noted that during convalescence from scarlet fever, and for sometime afterwards, special attention should be paid to the state of the kidneys. If any indications of dropsy appear in any part of the body, the attention of the physician should be called to this point at once.

ERYSIPELAS

Erysipelas is otherwise known by the Scottish name of "Rose" and as "St. Anthony's fire." It would appear to consist of a form of acute inflammation, specially having its seat in the skin and in the underlying tissues. Several varieties of this disease are recognised, the simplest variety affecting the skin-tissues alone; other varieties are distinguished according to the depth of the tissue they affect.

So far as the nature of this affection is concerned, it would appear that erysipelas is a germ-induced disease. The special microbe which has been regarded as the cause of the disease is known as a *strepto-coccus*, or germ of rounded form. It is noticeable that this disease frequently occurs as a result of infection of some wound or abrasion. It is therefore often seen after accidental lacerations of the skin, and also after surgical operations. In cases where erysipelas appears spontaneously and without any break of the skin representing the avenue of infection, physicians are inclined to believe that the real mode of entrance of the germs into the body has simply escaped notice. This is a reasonable enough view of matters, seeing that erysipelas in this respect presents a certain likeness in this mode of infection to such a disease as "lock-jaw." We know that in the case of this latter ailment infection is only likely when the germs have gained access to the body thrcugh some break of skin tissue, and applying this principle to erysipelas, we may readily conceive that while no lesion of the skin may be apparent, some solution of the continuity of the body has really existed either in the surface of the frame itself, or in some of the internal membranes.

Outward Conditions.—There can be little doubt that erysipelas is a disease in which a very marked effect is exercised as regards its attack by the presence of insanitary conditions. Wherever dirt and filth and refuse are allowed to accumulate in the neighbourhood of human habitations, erysipelas is apt to supervene. In consequence, an ailment which may be otherwise trifling in its nature may develop this serious affection. An illustration of this important fact is found in the case of children whose *vaccination* has been followed by the development of fatal erysipelas. In such a case the anti-vaccinator blames the operation itself for the fatal effects. The real explanation of such a case is, that the scratches of the vaccinator made in the arm of a healthy child living in pure surroundings would have had no other effect than in inducing the ordinary symptoms of vaccination itself. Exposed on the other hand to insanitary conditions, the slight operation involved in vaccination infects the system with the germs

of erysipelas derived from the filthy surroundings. It is important to note this fact, because the anti-vaccination party make much of so-called cases of "fatal vaccination." This result is seen therefore to be due not to vaccination itself, but to the surroundings of the patients. The same results might have followed upon the infliction of an ordinary scratch, apart from vaccination altogether.

The Age Period.—In this disease there is no protective influence conferred by a first attack. It appears to be most common from twenty to forty or forty-five years of age. There seems to be no difference observed in the degree of liability of infection of either sex. Erysipelas is most frequently seen affecting the face and the head.

Symptoms.—The preliminary symptoms are ushered in by a sudden elevation of temperature, exhibiting a rise to 102 or 104 degrees. Local symptoms appear, consisting of extreme heat in the affected part. There is headache with shivering, and vomiting may also occur; over the seat of the attack the skin becomes tightened, tense, and reddened. It also exhibits a certain amount of swelling. A curious feature of the disease is that it may be limited in its attack by certain conditions of body, represented chiefly by any distinct fold of the skin. Thus it may be stopped where the hair of the head begins, at other times it may extend beyond such limits, and the whole face and head become swollen and reddened. The eyes become practically lost in the swelling, and the face becomes an inflamed and bloated mass of tissue. When the inflammation has reached its height there may be a sudden cessation of the symptoms, but in many cases relapses occur. Incidentally, headache with delirium is found, and the patient may pass into a state of unconsciousness. The general health of the body is much disturbed, and disorders of the digestive system ranging from constipation to diarrhœa may be represented.

Aggravating Conditions.—This disease must be viewed much more seriously in the case of a drunken person, or at least one addicted to the use of alcohol, than in a sober and temperate man. The typical subject of erysipelas following an ordinary scratch or injury, which in a healthy man would heal in a day or two without other symptoms, is, say, a brewer's drayman. This class of person is accustomed to excess in the matter of ale and stout, and if he happens to be what is called of a bloated or *plethoric* habit of body, he presents favourable conditions for the development of this ailment. We may assume here that the body in such a case forms a typical soil for the special seed in question, this being represented by the germ of erysipelas. Occasionally this disease has appeared in an epidemic form, and in the olden days and before the development of antiseptic treatment, it literally devastated hospital wards.

Treatment.—The treatment of erysipelas should be commenced by the administration of a purgative. A dose of calomel and jalap, or other purgative, should be administered, by way of clearing the bowels. It is an undoubted fact that *iron* is a specific in this disease. The particular form in which the drug is administered is that of the tincture of the perchloride of iron. This should be given to the extent of thirty to forty drops every three hours in water, until the temperature is found to be lowered, when the medicine may be reduced in quantity.

In erysipelas, if the fever runs high and delirium and restlessness appear, a bath of a temperature of 80° Fahr. should be given twice daily, the patient remaining in it for twenty minutes. Quinine has also been prescribed in this disease, the dose being six or eight grains given every six hours.

Local Treatment is useful, and the usual method of applying it is that of dusting the inflamed part with flour or powdered starch. In other cases the parts have been painted with castor-oil or collodion, or with a mixture of the two. An excellent application in erysipelas is that of mixing ichthyol and lanoline, equal parts, painting this on the inflamed surface and covering it with gauze. Koch's remedy is creolin: one drachm of this substance is mixed with four drachms of iodoform and ten drachms of lanoline to make an ointment, which is applied to the parts, and then covered with lint and oiled silk.

Limiting the Attack.—A singular effect has been long known to physicians in the shape of the observation that when a line has been drawn by the application of caustic (or nitrate of silver) around the inflamed parts, the inflammation does not tend to pass beyond this line. Here it would appear that by the application of the caustic an interval in the skin tissue is made, so that the germs of the disease find themselves intercepted, and cannot pass beyond the boundary thus defined. The practice has been specially successful in connection with erysipelas of the leg.

Diet.—In the treatment of this disease the diet requires to be of a nourishing description. Milk, invalid bovril, eggs beaten up, and the like, with meat soups, may be given. Where the pulse tends to fall and the temperature also to be proportionately affected, the administration of alcohol is to be recommended. Small quantities of brandy or champagne may be given at frequent intervals.

SMALL-POX

Small-pox is a disease of very ancient nature, and has long been known to medical men. It is said that in Eastern countries this disease has been recognised for two thousand years. As regards Europe, it is generally estimated that small-pox has been known from the sixth century of the Christian era. Respecting the seat or place of endemic origin of small-pox, India and the Soudan are generally quoted as localities exemplifying this feature of the disease, but, as is only too well known, small-pox appears to be an ailment which tends from time to time to spread over large areas of the earth's surface. Of old, small-pox was an extremely fatal disease, and those who recovered from the ailment exhibited the marks of the trouble in the shape of the pitting or scarring of the face, occasionally seen even in our own time. Since the introduction of vaccination the effects of small-pox, as seen in scarring, have not only been tremendously reduced, but the death-rate of the disease has likewise been made to decrease in a very marvellous and satisfactory fashion.

Season and Race.—Small-pox in Britain appears to be a disease which most frequently occurs from January to June; the line falls below the average from July to December. It would appear that whilst no race is free from attack, negroes appear to exhibit a special susceptibility to this disease. In their case the death-rate is higher, whilst infection appears to be more readily acquired by black peoples. This result is attained irrespective of the fact that white races have been subjected to the influence of vaccination for a considerable period. No doubt exists that small-pox is a germ-produced disease, but the particular microbe which may be regarded as its cause has not yet been isolated and identified. Some observers have suggested that small rounded microbes called *micrococci*, which are found in the lymph or matter of small-pox pustules appearing on the skin—and such as also occur in the lymph used for vaccination—represent the source of the disease. This view has, however, yet to be substantiated.

Vaccination and Inoculation.—Referring first of all to *vaccination*, it may be here remarked that, between 1718 and 1721, Lady Mary Wortley Montagu, wife of the British Ambassador to Constantinople, described in her letters a certain process in vogue amongst the Turks for the prevention of small-pox. This practice was termed *inoculation*. She described the practice of Turkish women whereby they employed actual small-pox matter from the pustules of the disease. This matter was used to inoculate a healthy person, and as a rule produced a mild form of small-pox, this mild attack preventing the

inoculated person from any subsequent invasion. The practice of inoculation was tried in England, and it undoubtedly conferred a certain amount of freedom from what may be called ordinary or virulent small-pox attack. Inoculation, however, as may be seen, did not protect against small-pox save by inducing an actual attack of that disease, and mild as the attack was, each inoculation, nevertheless, resulted in what was an actual case of the disease, with all its attendant risks of infection to those around.

When Jenner in 1796 discovered vaccination, inoculation became speedily obsolete. It may be here mentioned that the probable reason why an attack of small-pox caused by inoculation was much milder than that acquired by infection in the ordinary way, depended upon the fact that the patient was infected directly through his blood. In ordinary small-pox infection the process is one of swallowing or breathing in the microbes or germs of the disease. We thus note that different modes of infection imply differences in the degree of the development of diseases. Inoculation at the present time is an entirely illegal procedure, being prohibited by law, thus following out the sound principle that it is not warrantable under any circumstances to convey actual disease from those who are sick to those who are healthy.

Edward Jenner was a surgeon practising in Gloucestershire, which is a typical dairy county. It was on the 14th May 1796 that Jenner was able to state definitely his views regarding the protective influence of vaccination against small-pox. It had been noted that where milkers of cows had been infected with the matter from pustules forming on the teats or udders of the cows, they showed an insusceptibility to small-pox attack. Proceeding on the lines of this observation Jenner made experiments whereby he transferred from the hands or arms of dairy servants this matter to other persons. This procedure practically represented the beginning of vaccination. From the hands of one Sarah Nelmes, who had acquired vaccine pustules from the cow, matter was inoculated into the arms of James Phipps. On his arm appeared the usual pustules seen in ordinary vaccination. James Phipps was afterwards inoculated with actual small-pox matter, which in an unprotected person would have had the effect of conveying to him an attack of small-pox. No disease attack followed this "inoculation" of Phipps, and this result, along with others of a similar nature, served to strengthen in Jenner's mind the idea that matter obtained from the cow as already described, and used for the vaccination of a human being, formed a means of protection against the attack of small-pox.

It is not necessary here to enter into statistics by way of showing

what all medical experience of small-pox epidemics proves, namely, that *efficient vaccination* will, in the vast majority of cases, protect against small-pox attack. It is also provable that even inefficient vaccination is capable of modifying the course of the disease. Furthermore, a very important point is that which teaches us that if vaccination be practised on a patient who has been infected by small-pox, the course of that disease, if not absolutely arrested, will be very much modified in consequence of the operation. Thus successful vaccination, it is stated, performed within three days after exposure to infection, prevents the development of small-pox. If vaccination of a person infected with small-pox be delayed as late as the fifth or sixth day thereafter, small-pox may even be arrested, or if it proceeds towards development, will be converted into a mild attack. These facts are to be regarded as extremely interesting proofs of the actual power of vaccination to modify the course of small-pox, even if it has, so to speak, gained a certain hold upon the body.

Referring backwards to the question of vaccination, we may hold that the substance or *lymph* which is obtained from the cow represents the development in that animal of a disease known as *cow-pox* or *vaccinia*. This disease, it is undoubted, was formerly very prevalent among cattle, but it appears to be of somewhat rare occurrence now. It has already been noted that one of its prominent symptoms is the development of pustules or small swellings on the teats or udders of cows. The substance or lymph of these pustules can be used for inoculation upon cows as well as upon men, and vaccination would therefore appear to consist in the transmission of *vaccinia* or cow-pox to man. If it be asked how this process should influence small-pox, we might suggest that "cow-pox" really represents "human small-pox" modified by its passage through the blood of the cow.

In the case of vaccination, the pustule in man generally forms on the third day. On the fifth or sixth day it develops fluid or becomes what is called *vesicular*. About the eighth day the vesicle ripens and contains lymph. About the ninth day the lymph or clear fluid of the vesicle shows a tendency to become developed into "matter" or *pus*. At this stage a certain degree of fever may be present. Later on, about the tenth day the vesicle bursts, and then dries and scabs. The scale falls off about the end of the third or during the fourth week, and a scar is left at the part which is termed a "vaccination mark."

Of old vaccination was carried out on the "*arm to arm*" system, one infant being vaccinated from the matter developed in the pustule of another. The lymph was generally collected from the child's arm on the eighth day or about a week after vaccination had been per-

formed. The lymph, however obtained, is passed up into glass tubes or dried upon ivory points. It remains active for a certain space of time and can thus be preserved for use.

To-day "arm to arm vaccination" has somewhat passed into the background, and it is regarded as a much more satisfactory proceeding to vaccinate with lymph obtained directly from the calf. This practice has obvious advantages, the chief being that lymph obtained from the calf directly, is less likely to undergo any modification from the human side, and constitutional disease which may be present in the infant, and the risk of transferring it also, are thus avoided. By means of treating calf lymph with glycerine it is found that any microbes which may exist in the lymph, and which may produce effects other than those of vaccination, are killed and destroyed, leaving the special active principles of the lymph, to which the benefits of vaccination are due, unaffected.

Effective Vaccination.—There can be little doubt that in the early days of vaccination this operation was ineffectively performed. To-day, physicians recognise that for an individual to be perfectly protected against small-pox, it is necessary to secure at least three or four definite scars or marks. Protection against small-pox seems to be directly related to the efficiency of the vaccination. It is desirable that the scars should occupy not less than half a square inch of space. Yet another point is of extreme importance connected with the question of *re-vaccination.* Of old, one vaccination was regarded as being sufficient for life-long protection from small-pox. Subsequent experience has shown the erroneous nature of this opinion. All physicians to-day regard *re-vaccination as an absolute necessity* in so far as regards protection against small-pox attack. It may be said that the result of the first vaccination may last from seven to ten years, although, if re-vaccination be performed within five years, definite results may be produced thereby. Re-vaccination is therefore recommended after having been performed in the infantile period. At the age of twelve or thirteen years re-vaccination should be performed, and it is by no means an unusual or useless custom to re-vaccinate during the prevalence of a small-pox epidemic.

The fact that many persons vaccinated in infancy, and also at a later period, are susceptible to re-vaccination during adult life, tends to show that while the protective influence of a first vaccination undoubtedly modifies the course of small-pox attack, absolute safety can alone be obtained through another and subsequent vaccination.

Objections.—Objections to vaccination are of course of numerous kinds. They may be summarised under the notion that the nature of the disease in the cow has not been definitely ascertained, that

it is not proved that it is "cow-pox," and that proof is wanting of its protective effect against small-pox attack in men. To these objections perfect answers have been returned by those medical men, who, having the superintendence of small-pox hospitals, or who as medical officers of health have the supervision of towns where small-pox epidemics have occurred, find reason, without prejudice, to exhibit their entire confidence in vaccination as a preventive against small-pox invasion. There is an obvious danger as well as irrationality in the expectation of a certain class of objectors that every vaccinated person should be claimed by medical men as protected against small-pox. We must have regard to the fact that human constitutions differ materially one from the other, not merely in respect of vaccination, but also with regard to foods, drinks, and all other circumstances of life. The law that when dealing with living beings we cannot expect mathematical certainty in results, should be clearly borne in mind here. It is not expected that in the case of say ten, twenty, or a hundred persons, duly vaccinated, there should be conferred an equal protection on all. What medical experience more than confirms is the fact, that taking the average of vaccinated persons, there is in each case (with the exception probably of those not susceptible to vaccination) a given amount of protective power conferred. This power or quality will be absolute in some and relative in others, while statistics fully prove that with regard to the attack of small-pox upon vaccinated persons at large not merely is escape from infection a common result, but the effect of the disease is strikingly modified in the case of the vaccinated from those who have not been vaccinated or who have undergone an imperfect operation of this kind.

A series of statistics collected from the experience of the London Small-pox Hospital demonstrates very clearly indeed how the mortality from small-pox attack diminished materially according to the perfection with which this operation had been performed. Thus the mortality per cent. of unvaccinated persons was 35½. Amongst those who said that they had been vaccinated, but who showed no marks thereof, the mortality was 21¾ per cent. In those having one mark the death-rate was 7½ per cent., in those having two marks 4⅛ per cent., in those having three marks 1¾ per cent., and those having four and more marks ¾ per cent. When we come to consider the question of re-vaccination we find that greater protective results still are here noted. In a Sheffield epidemic, of 8198 persons re-vaccinated before the epidemic 25 were attacked, with 1 death. During 1887–88, 56,233 persons were re-vaccinated. Of these two were "doubtfully attacked," and no deaths occurred.

German Experience.—The experience of Germany is also worth quoting in this connection. Re-vaccination is compulsory in Germany, and the result of this practice is, that there has been no serious epidemic of small-pox in that country since 1870–74. This fact contrasts very markedly with the reappearance of epidemics in other countries. With particular attention paid to vaccination in the German army cases are practically unknown in that body of men ; such cases as occur in the German empire are practically those imported over its borders.

Small-pox and Sanitation.—It has been claimed by anti-vaccinators that where a decrease in small-pox attack has occurred, this result is really due to improvement in general sanitation. This is entirely an erroneous view. Small-pox is not a disease liable to be conveyed to us by water, by bad drainage, or through the influence of a sewage-laden soil. The improved sanitary conditions which have certainly tended to abolish cholera and to limit typhoid fever, have therefore no influence whatever in limiting small-pox. It is a disease liable to be conveyed by contact with those who are sick, and its poison, as we shall see, is readily conveyed by clothing and even by the air. It is obvious therefore that in this case we are fighting an ailment which cannot be combated on the same lines that are found so thoroughly effective in the case of typhoid fever and other filth diseases. If, as can be shown, there has been a distinct reduction in small-pox mortality, this improvement, admitted even by anti-vaccinators, must be due to some cause lying outside ordinary sanitation. That cause is vaccination and vaccination alone. At least it is impossible to discover any other condition which should have operated between the year 1796 and the present time in reducing the death-rate from a disease formerly not merely much more prevalent than now, but also much more fatal.

The germs of small-pox are probably of such a character as to present very grave difficulties in tracking them to their origin. That they may exist for long periods in a state of quiescence and wake up into vitality when suitable conditions are presented is a statement scarcely admitting of doubt. If, furthermore, we have regard to the class of the community in which small-pox epidemics broke out—chiefly amongst the masses where carelessness in dealing with infected clothing and other details is only too common—we may readily understand why small-pox, given the conditions for its germ-development, should now and then or periodically exhibit a tendency to light up into an epidemic.

Incubation and Symptoms.—The *period of incubation* in the case of small-pox attack extends to about twelve days, and there can

be little doubt, as already stated, that any case of this trouble implies direct infection through its germs. The first symptoms of the fever are those of *rigors or shiverings* with a tired and weary feeling, forehead headache, and a rise of temperature which may amount to 103 degrees or so. Two very characteristic features of small-pox are found in *pain situated in the small of the back, accompanied by frequent vomiting.* These symptoms appear before the rash develops, and *they are absent in chicken-pox and other ailments.*

The eyes run with water, and saliva is developed in increased quantity in the mouth. The eruption appears on the third day of the fever on the forehead. It extends to the neck, hands, and body, and appears last in the legs. It consists of spots of a hard consistence and of rounded shape, each being distinct from its neighbours. The eruption has been described by physicians as presenting the feeling as if small shot were enclosed beneath the skin. It may be here mentioned that each of these pimples or papules remains distinct.

The attack of small-pox thus described is of *simple* or *discrete* character. In other cases the spots tend to run together, when we get what is called *confluent small-pox.* The latter is, of course, a more serious variety of the disease. Three days after the appearance of the eruption, *i.e.* on the sixth of the fever, the papules or spots tend to develop. They become filled with a clear fluid which gradually becomes of thicker character. Each papule also begins to exhibit a depression as if it had been pushed down in its middle. On the ninth day of the fever the points of each of these vesicles show a tendency to develop matter or pus. Around each a red ring of inflammation forms, causing a good deal of irritation, and also giving rise, apparently, to additional symptoms of fever. After this period the pus or matter tends to become absorbed, and the pustule, on or about the ninth or tenth day, breaks, and a scab is formed. These scabs are thrown off about the fourteenth day of the fever, and a red mark is left where each is situated. This mark in turn gradually disappears. In an unvaccinated person, however, this red mark develops into what is called a "pit," leaving then a permanent depression or scar in the skin. Where the pustules run together, and *confluent small-pox* is present, all the symptoms develop a more severe character. Especially are the effects seen in the face, which may exhibit a horrible appearance owing to the swelling due to the formation of large masses of the eruption.

In connection with small-pox it should be mentioned that, as in rheumatic fever, a *particular smell or odour* is characteristic of this trouble. In the case of confluent small-pox this odour may be of an

extremely disagreeable description. Complications are likely to develop in the latter variety of the ailment. The inside of the throat and mouth may be affected, whilst cough and difficulty in breathing are present, and there may be delirium or wandering in the mind.

Another variety of small-pox is known, which is called *black, malignant, or hæmorrhagic small-pox.* In the latter species of the disease blood appears to be effused under the skin, whilst bleeding may take place from the mouth and other surfaces. This form of small-pox represents an extremely dangerous form of the disease.

It has been noted that fever of a high character may precede the appearance of the eruption in small-pox, whilst it tends to abate when the eruption appears. What is called the *secondary fever* in this disease may appear about the seventh day of the eruption or ninth day of the fever. This secondary development of fever may be found even in the simpler and non-complicated cases of the ailment, but when it occurs in the confluent variety of the disease, it tends frequently to promote a fatal result. The secondary fever frequently develops complications in the shape of erysipelas, boils, and other effects.

The Power of Infection.—Infection in small-pox has already been described as of an extremely powerful and subtle description. Medical men believe that infection may be given off at the earliest period of this disease from the breath, but there can be little doubt that the skin with its manifestation of pustules in the shape of the eruption is also a very important source of invasion. There is no doubt also that infection may be readily carried by clothing and like articles, hence the importance of securing instant and sufficient disinfection of all articles with which a small-pox patient is associated. There is every probability also that the infection of small-pox can be conveyed to a certain distance by the air. It has thus been found that for a certain distance around small-pox hospitals a certain risk of infection is prevalent, this risk diminishing with the distance from the hospital. This fact conveys no reflection upon the process of disinfection carried out, as these are efficient enough in the case of all infirmaries devoted to the treatment of this disease. It merely indicates the extreme difficulty which is experienced in dealing with the microbes of this disease, a point the importance of which has already been noted in the consideration of our liability to infection from small-pox through its germs remaining latent, and through their liability to be diffused in various ways, thus giving origin to fresh epidemics.

Isolation.—*If a person be exposed to infection of small-pox,* he should be kept isolated from all other persons until a lapse of seventeen

days, and he should be required to be re-vaccinated. *After the fever has disappeared* the patient should not be allowed to mix with others for some weeks, and a test of the safety of others in this connection is marked by the disappearance of all the scabs from the pustules. This process, it may be added, takes six weeks to be effective, and in many cases an even longer period. Second attacks of small-pox, as has already been remarked, are not common, but even third attacks have been recorded in the history of medicine.

Treatment.—The *treatment* of this disease illustrates a previous remark that in a perfect state of civilisation every case of infectious disorder would be removed to and be treated in a hospital specially reserved for infectious disorders. Unless the *efficient vaccination of the household* has been carried out, the occurrence of a case of small-pox therein will most usually imply a very strong risk of infection. The treatment of small-pox is in itself fairly simple, and is carried out according to the rules already given for the treatment of fevers at large.

The room in which a patient is treated should be kept cool (55 to 60 degrees), whilst an efficient ventilation should be provided. The diet will be of light character. *It is important that the room should be kept dark* in order to avoid irritation to the eyes. Some Continental physicians, particularly, have argued that the only light admitted to small-pox patients should be *red light*. They claim for this treatment that it not merely affects the course of the disease, but has marked effects in preventing the pitting of the skin common to the trouble.

It will be well to administer an ordinary saline aperient occasionally, whilst soda-water and lime juice may be given to alleviate the thirst. The *itching* which attends the eruption may be alleviated by smearing the skin with cold cream or vaseline, or with Carron oil (which is a mixture of equal parts of lime water and linseed oil), or by using carbolic acid ointment or carbolic oil of a strength of one to forty. Another favourite application for the skin is eucalyptus oil, one part to five parts of olive oil. Some physicians recommend that icebags be applied when the eruption is extremely irritating. At a later stage, when the spots have burst, a dry starch powder to which a little oxide of zinc has been added may be applied. A daily warm bath will be found extremely useful, a little bi-carbonate of soda being added to the water. Thereafter, cold cream or some similar substance may be applied to the skin.

Diet.—With respect to the *diet*, milk, invalid bovril, strong beef-tea, and the like substances may be given. For any restlessness or want of sleep a mixture of bromide of potash and chloral may be prescribed. This mixture has already been described, and consists of

three drachms of bromide of potash, two drachms of chloral, and six ounces of water. The dose is a tablespoonful every two or three hours when restlessness prevails.

Stimulants may be given where prostration and depression are present, and if the mouth and the throat be affected a gargle of chlorate of potash may be given. Borax and glycerine, one part to six, may also be used as a throat-application. Black currant jelly is also recommended as an application for the throat in this disease. *The nurse should never lose sight of the patient* in a case of small-pox for fear of complications occurring and of delirium supervening. A night and a day nurse are therefore necessary in the treatment of a small-pox case. It is well also that the hair should be cut short.

CROUP

This is a disease which in former years was regarded as essentially distinct from diphtheria, but the tendency of modern medicine *is that of regarding croup as a variety of diphtheria,* presenting, however, less marked symptoms than the latter disease, and not attended with the same risk of death, or with the development of complications such as are common in diphtheria. In croup we find a membrane or thin layer developed on the throat and upper part of the wind-pipe. It will be noted in the case of diphtheria that when this membrane is stripped off, an ulcerated and bleeding surface is left below. In the case of croup this latter feature is absent, hence it may be concluded that if croup and diphtheria are diseases originating from the same source, the former is a very modified form of the common ailment.

Symptoms.—In croup the ailment begins with fever and with symptoms which attack the organ of voice. A sore throat is complained of, and the cough is of a harsh nature. As the disease progresses, the child shows symptoms of difficult breathing. It may frequently wake up at night troubled with such difficulty. At first the attacks are separated by intervals, but soon the breathing trouble becomes permanent. Respiration is interfered with, the voice practically disappears, and a bluish condition of the skin, due to imperfect aeration of the blood (and known as *cyanosis*), is witnessed.

Croup is a disease which runs a fairly rapid course. It does not as a rule last beyond thirty-six or forty-eight hours. In fatal cases twelve hours may prove sufficient to produce the untoward result. When reaction occurs, the child will cough up the membrane which has formed in the throat, whilst the cough loosens, the skin grows moist, the fever vanishes, and the voice assumes its natural

character. Many physicians regard croup as really an acute form of laryngitis or *inflammation of the organ of voice*, but this opinion would appear to be opposed by the fact that a membrane forms such as is not seen in ordinary cases of *laryngitis.*

Treatment.—The treatment of croup is that referred to under the head of diphtheria, where the inhalation of steam from a bronchitis-kettle is described. A hot bath should be given to the child, and hot sponges applied to his throat. It is important to cause vomiting here. Ipecacuanha may be used, the dose being a teaspoonful of ipecacuanha wine, repeating the dose until vomiting is produced. If this is not successful sulphate of copper may be given. Ten grains are dissolved in two ounces of water, and one teaspoonful given every five minutes until the desired result is effected. The vomiting has the effect of expelling the membrane formed in the throat.

For a child of one year old affected with croup the following mixture has been recommended: One grain of the tartrate of antimony, four drachms of ipecacuanha wine, four drachms syrup of squills, and water up to three ounces. A teaspoonful dose should be given every quarter of an hour until vomiting is produced; afterwards half a teaspoonful every two or three hours so long as the cough is persistent. The bowels should be acted upon by an injection of soap and water. Some physicians apply a solution of nitrate of silver or caustic to the membrane by way of arresting its development.

It should be noted that in the case of croup there is a liability to a fatal result from this disease, and the rule observed by medical men is that after twelve hours' treatment, if no relief be obtained, the operation of opening the windpipe (*tracheotomy*) should be resorted to. Another procedure, called *intubation,* where a tube is inserted into the upper part of the windpipe so as to permit air to pass in and out of the lungs, is often resorted to in place of tracheotomy.

It may be mentioned that another disease exists liable to occur in delicate children under two years of age, viz. *Spasmodic Croup.* By medical men this disease is known as *laryngismus stridulus.* This disease appears to have a purely nervous origin. It occurs as a rule during sleep, and the child is wakened up by a difficulty in breathing. It appears to be on the verge of suffocation. When the spasm terminates, it is able to draw air into the lungs, and this action is accompanied by a crowing sound which is characteristic of the trouble. The disease may also induce contraction of the muscles of the fingers and toes. It usually ceases as suddenly as it appears, but it may be attended with danger.

In this case there are no preliminary symptoms, and this *false croup* is therefore recognised not merely by its sudden appearance

but by its equally sudden cessation, whilst there is no fever, cough, or hoarseness of voice. The treatment of false croup is at once to give the child a hot bath, and to apply sponges wrung out of hot water to his throat. On taking the child from the bath the face and chest should be sprinkled with cold water.

A dose of bromide of potassium (from ten to fifteen grains for a child from 8 to 10 years of age) may be given to the child by way of preventing a recurrence of the symptoms, and attention must be paid to its general state. As this affection is often an accompaniment of teething, the gums should be lanced, and strict attention directed to the state of the bowels. Where a child is liable to such symptoms occurring after cold, it is said to suffer from "False Croup." It wakes up suddenly in the night with a very harsh hard cough, and shows a kind of "crowing" with each breath taken in. Here we have to deal with a trouble due to a mild attack of inflammation of the organ of voice. No membrane is formed as in true croup and diphtheria. Ipecacuanha wine should be given as above described, so as to produce vomiting. The main line of treatment here is to apply warmth to the throat by means of a sponge wrung out of hot water as already described.

DIPHTHERIA

This disease was only perfectly defined about the year 1826. Previous to that period it was recognised as a form of *malignant sore throat* of a dangerous character, and an ailment much more commonly seen in children than in adult persons. Formerly a disease of rural districts, diphtheria has gradually encroached upon towns, and it may be considered now to be an ailment characteristic of urban rather than of rural populations. If we denominate diphtheria "a filth disease," we shall have indicated thereby an important feature with respect to its environment. It is an ailment the germ of which flourishes like that of typhoid fever amidst insanitary surroundings. It is known to develop, for example, amidst sewage, especially of putrefying nature; hence an insanitary condition of houses and of surroundings at large tends towards the production of this disease.

There is no doubt that certain lower animals are liable to suffer from this ailment. Cats especially, but also pigeons, fowls, and horses have been noted to be affected by symptoms resembling those of the disease in the human subject when an epidemic of diphtheria has been present. As we know that the cat particularly has the power of infecting beings with diphtheria, and in turn of being infected from them, it is probable that infection may be derived in many cases (by way of starting an epidemic) from the lower animals. The modern tendency

of medical opinion where detached cases of diphtheria occur is therefore to regard all such cases, in accordance with the great law applying to infectious diseases as really representing developments from preceding attacks.

Infection.—A very important point in connection with infection from diphtheria may here be mentioned. When a patient has recovered from this disease and is perfectly convalescent, the germs can be obtained from his throat-parts for many weeks or even months after his recovery. Here we have a case in which the disease having, so to speak, ceased in the individual, continues to exhibit a passive prevalence in his case. He himself does not suffer from the presence of its germs in his throat, because he has been rendered immune to further attack by the disease period through which he has just passed. But such an individual presents us with a source of infection, in so far as other persons are concerned. Schools, for example, are well known to form *foci*, or centres whence diphtheria epidemics may start. If we suppose the case of a child who has recovered from diphtheria, and after a certain period of convalescence has been allowed to return to school apparently cured, but who nevertheless still retains the germs of the disease in his throat-parts, we may readily conceive how a fresh outbreak may take place. In schools children are closely associated together; they use their saliva for the cleaning of their slates; they may use the same towels, and as even the breath may be liable to convey the germs to healthy persons, it is not difficult to account for so-called "mysterious" outbreaks of this disease, on the ground that powers of infection long remain in patients after all the active symptoms of diphtheria have totally disappeared.

Otherwise, diphtheria may be conveyed to us by means of milk. There is not the slightest doubt that a person connected with a dairy, suffering from a slight attack of diphtheria, may thus infect the customers of the establishment. It has been noted that a disease allied to diphtheria has been traced in the cow. As in the case of scarlet fever, so in that of the disease under notice certain of our attacks may really originate from lower life. The germs of diphtheria are known to multiply quickly and readily in milk.

Bad Drains.—It was noted in the case of typhoid fever that exposure to the influence of sewage gases had a marked effect in the matter of the lowering of the vitality of the system, and in rendering the patient more liable to attack. Of diphtheria the same remark holds good. There is no doubt whatever that persons living in houses the drainage of which is of imperfect description, or those inhabiting dwelling-places the soil of which has become impregnated with sewage matters, if not actually liable to derive infection from their surround-

ings have their systems so lowered that if diphtheria germs exist in their vicinity they become open to attack.

The Germ.—The microbe of diphtheria is well known. It is associated, however, with a number of other germs known as those of *pseudo-diphtheria*. The germs are capable of retaining their vitality for months in a dried state, and this fact may possibly explain to us cases of infection derived from extraneous sources, and not capable of being explained by contact with diphtheria-patients. As has already been remarked in the case of scarlet fever, the part played by the pseudo-diphtheria germs in inducing disease attack is uncertain, but a prevailing opinion leans to the belief that diphtheria germs themselves are assisted in their work by the presence of the microbes with which they are thus intimately associated. It would appear that diphtheria attacks more males than females between the ages of three and forty-five, but in both sexes the tendency to diphtheria increases from the period of infant life attaining its height about the fourth year.

Incubation.—The incubation period of diphtheria appears to be of short character, but exhibits considerable variations in respect of the time of manifestation of the first symptoms of the disease. At as early a period as a few hours after infection, onwards to seven or fourteen days, are described as the limits of its incubation.

Symptoms.—A certain amount of fever attends the onset of this disease, but the exact degree varies very greatly. There are symptoms of general uneasiness, headache, and inability to perform work. Successive symptoms are stiffness of the muscles, with swelling below the lower jaw. Difficulty of swallowing soon appears, and along with these throat symptoms there is pricking of the throat, with darting pains in that region. When the throat is examined it is found to be very much reddened and inflamed. Later on, we find white patches appearing over the surface of the back of the mouth and upper part of the throat. These patches very soon tend to run together and become confluent, thus forming a membrane which extends over the whole throat. This membrane is called *the false membrane*, and affords a characteristic indication that diphtheria is present. At first it can be easily stripped off, but another development of this membrane will then take place. Then it can only be torn off with the result of leaving a bleeding surface below. Left to itself, and if the disease terminates favourably, it parts company with the throat, or as the medical man says, "*sloughs off*."

The temperature in diphtheria may not necessarily be of a high character. The average is usually between 100 and 102 degrees, but on account of the depression induced, it may even sink below the normal point of 98.4 degrees.

Later on the disease extends up to the nostrils, and also backwards into the *larynx* or *organ of voice*, and to the *windpipe* itself. The neck may become swollen owing to the inflammation produced. At this stage the breath assumes a most disagreeable odour, and swallowing becomes practically impossible. The breathing is also naturally interfered with, and a notable point in connection with diphtheria is the occurrence of *paralysis* of the muscles of the organ of voice. It may be added that *paralysis of other muscles* is a symptom which often occurs in this disease. Later on, at about the seventh day, the disease reaches its height, and recovery then takes place.

In the case of diphtheria, convalescence extends through a long period, but as has already been mentioned, complications are apt to result in the shape of kidney troubles and lung affections, with paralysis of the muscles, not merely of the organ of voice and swallowing, but also sometimes of the muscles of the limbs. This paralysis it is interesting to note generally passes off as the patient progresses towards health. The period of convalescence may extend to two or three months, and it is a disease which is certainly liable to fatal termination more frequently in children than in adults. Eye troubles and skin affections are also liable to occur in the course of this disorder. It need hardly be said that the symptoms of diphtheria both of a local kind and of a constitutional nature just enumerated, are due to the effect of the toxin or particular poison which is generated by the germs of the disease. This poison extending not merely to the muscles but also to the nerve centres, accounts for the symptoms of paralysis and other troubles liable to attend this ailment.

Treatment.—In the *treatment of diphtheria* we have two sources of attack as regards the disease. These are, first, all represented by means intended to attack the disease at its special seat in the throat, and second, treatment which has for its aim the strengthening of the constitution against the effects of the ailment. Naturally *local treatment* applied to the throat is intended to limit or destroy the group of diphtheria germs in that situation. Physicians often employ a solution of lactic acid of the strength of one part in eight of water to clear away the superficial layers of the membrane of the throat. A disinfectant lotion or fluid can be applied to the throat by means of pads of cotton wool tied or fixed to any convenient object. Carbolic acid has thus been used with great success. A solution of fifteen minims of carbolic acid dissolved in one ounce of glycerine and one of water may be applied frequently by means of a pad or small sponge. Needless to say it is imperative at once to destroy by burning the pads or sponges used, employing fresh ones for

subsequent applications. Some physicians in approving of the application of gargles in this disease use glycerine of borax and apply this freely to the throat parts. If this substance be diluted with four or six parts of water it can be used as a gargle. Hydrochloric acid in a very diluted state can also be used frequently as a mouth wash. A solution of chromic acid has also been employed for the purpose of painting the throat, but in all probability, where such applications are used at all, carbolic acid may be preferred.

Inhalations.—It will be understood that where diphtheria advances beyond a certain stage there will be incurred a risk of suffocation owing to the blockage of the windpipe by means of the false membrane. In such an event there can be little doubt that the proper treatment is at once to begin the inhalation of hot vapour in the shape of steam allowed to pass into the bed, which should be covered over so as to make a kind of tent, the steam being provided from a bronchitis-kettle provided with a long nozzle, as will be duly described in the section of this work devoted to the duties of the nurse. In later stages where a fatal result appears imminent, the services of the surgeon are required in order to perform the operation of *tracheotomy*, which consists in opening the windpipe in order to admit air by means of a tube inserted in the opening. Another operation, that of *intubation*, may also be performed by the surgeon in such cases. It may be noted here that in the vast majority of cases of diphtheria such operations tend to be performed too late in the day to bring about a successful result. Parents very naturally look with some degree of alarm upon surgical operations at large, and more especially upon those of the character just described. But if the medical man warns parents of the probable necessity for such an operation they will be well advised if they will consent to its performance on the earliest possible occasion. In this way recovery from the operation is more likely to occur, seeing that at a later stage the strength of the little patient is so exhausted that reaction after the operation becomes practically impossible.

With reference to the *medical or general treatment* of diphtheria there can be little doubt that all physicians are agreed regarding the necessity for the free administration of stimulants in this disease. Even in the case of children stimulants may be freely given. An author puts this point directly when he says: "The liberal use of alcoholic stimulants is imperatively demanded as the principal, and when food is rejected, as the only means of supporting life during the most critical period of the disease." In the case of even young children five ounces of brandy have been given in twenty-four hours, and even larger quantities may be administered with good effect if the

nature of the case appears to demand such treatment. All the food must of course be of liquid character, and should consist of nourishing soups administered as often as the patient can take them, and in as large a quantity as he can conveniently swallow them. If inability to swallow nutriment exists, such a form of diet must be administered by the bowel.

Drugs.—Internal medicines, as a rule, are limited to the giving the tincture of the perchloride of iron with or without glycerine in fairly large doses. The prescription adopted for this purpose is composed of two drachms of the tincture of the perchloride of iron, forty grains of chlorate of potash, one ounce of glycerine, and six ounces of water; the dose is a teaspoonful given frequently.

Quarantine.—With reference to *the period of quarantine* in cases of diphtheria, reference may be made to the fact already noted, that the germs of this disease are liable to remain in the throat of the patient for a considerable period after recovery. The tendency in so far as regards exposure to infection, and the period that a person should be well looked after and isolated in case he develops the disease, may extend to fourteen or twenty-one days. But after recovery great attention should be paid to the state of the throat. If the germs of this disease are liable to remain in the throat of a recovered patient, it is clear the attention of the medical man and of the parents should be directed to what may be called the toilet of the throat. Infection may be largely prevented by keeping the patient at home for a much longer period than is usually practised, whilst the daily use of antiseptic gargles should be carried out. Such gargles may be made by adding a few drops of Izal to half a tumbler of water, or a weak solution of carbolic acid may be used. These measures would undoubtedly tend to the prevention of infection from the recovered patient, and thus protect the community (and especially the school) against a possible attack.

THE ANTITOXIN OR "SERUM" TREATMENT OF DIPHTHERIA

Within recent years and as a practical application of the germ theory of disease, a new treatment has come into vogue known by the above name. It has already been explained that when germs attack the body, multiply in the blood, and thus tend to produce a given disease, this effect is attained through the development of a particular poison as a *toxin*. It would appear that later on in the course of disease developments there is also produced another substance called

the *antitoxin*. This last exercises a deleterious effect on the growth of the germs. Hence recovery from many microbe-produced diseases is attributed by physicians to the presence of the antitoxin modifying the course of the ailment through its effect in causing further germ growth to cease.

Bacteriologists have discovered that it is possible to produce *antitoxins* artificially by inoculating another animal than man with pure cultivations of his disease germs, and obtaining from the blood of the animal in question a substance called a *serum or antitoxin*. This substance when injected into the human body acts, as has already been explained, as an antidote to the germs which attack it. The mode of treatment here may be described as one in which the products of germ life are made to attack, fight, and destroy the microbes themselves.

Reference has been made in the case of cholera and typhoid fever to *antitoxins*, which have been employed to limit the mortality of these ailments, but it may be said that the greatest success in this line of treatment has been obtained in the case of diphtheria. Pure cultures of the germs of diphtheria are made, and are used to inoculate the blood of the horse. After successive inoculations, extending over a certain period, have been made, the blood of the horse is found to develop an antitoxin. When this latter substance is employed and is injected into human patients suffering from diphtheria, reaction occurs, and the progress of the disease is arrested. It may also be added that inoculation of a human body with this serum tends to convey for a certain time a protective influence, rendering the subject non-susceptible to diphtheria infection.

This "serum treatment" (so-called from the fact that the antitoxin is found in the *serum* or *fluid part of the blood*) has entirely altered the treatment of diphtheria, and has markedly reduced the mortality from this disease. There can be little doubt that the success of this treatment depends on the early period of the disease at which it is employed. One series of statistics shows that in 412 cases in which it was employed on the first day less than 1½ per cent. developed complications. In those treated otherwise 16 per cent. developed the latter results; even after the operation of opening the windpipe has been performed, the administration of the antitoxin has markedly increased the number of successful cases.

A recent report (for the year 1902) of the Metropolitan Asylums Board of London gives some interesting statistics regarding the use of this mode of curing diphtheria. It is said that a few years previously to 1892 the death-rate from diphtheria in the hospitals under their control amounted to over 30 per cent. After the use of the antitoxin treatment, the mortality fell to 11 per cent. The

report also lays stress on the fact *that the success of this remedy depends on its early application,* and the opinion is expressed that if the serum treatment could be applied on the first day of the disease a fatal termination would almost inevitably be prevented.

This latter mode of treatment of diphtheria represents, therefore, a veritable triumph of bacteriological science; and without unduly forecasting the future, it may be said that if in the case of other diseases cultivation of their germs could be possible, and also if the production of serums, each adapted for the cure of its own ailment, could be made general, medicine would be placed in the position of being able to treat germ-produced ailments not by drugs, or even by general measures, but by veritable specific remedies, adapted to attack and defeat in the most direct fashion the microbes to which such ailments are due.

CHICKEN-POX

Chicken-pox is also known by the name of *Varicella.* This disease may be accounted one of the simplest of the fevers, for in the first instance the rise of temperature is never great, and although a certain risk of complications exists, that risk is small, so that the mortality from this disease is by no means large.

The Rash.—Chicken-pox is typically a disease of young children. The rash appears as a rule on the first day of the fever, and develops in the form of small pimples. On the second day these pimples develop in their interior a fluid, burst on the fourth day, and then quickly disappear. The first appearance of the rash of chicken-pox is on the neck, chest, or shoulders. It may pass to the head, but does not as a rule develop on the face.

An important point with regard to this disease is its liability to be mistaken for small-pox, or on the other hand that the more serious disease, small-pox, may be mistaken for chicken-pox, in which latter case serious results with regard to the infection of healthy persons may arise.

In the case of chicken-pox we should note that, instead of the more serious symptoms which mark the invasion of small-pox, we have practically *little fever* and *little disturbance of the general system in the case of chicken-pox.* Furthermore, in the *case of small-pox the eruption is first developed on the forehead,* whereas in chicken-pox, as we have seen, it tends to *appear on the trunk of the body.* Again, the eruption in chicken-pox *very rapidly develops fluid* with it, whereas a longer course is found before the eruption of small-pox develops its characteristic matter.

Infection and Incubation.—Infection here is probably conveyed by actual contact with an affected person or by clothes and such-like articles. The breath is regarded as the chief source of infection. It is highly probable that chicken-pox represents a disease in which infection is liable to pass freely abroad. In this disease a second attack may be regarded as rare. It is believed that in chicken-pox the incubation period extends to about fourteen days. The eruption is often attended by severe itching, and if the child is allowed to scratch itself matter may be developed in the rash. It is a rule in chicken-pox that the amount of fever will correspond with the development of the rash. As has already been indicated, a high temperature is somewhat rare in this trouble.

Treatment.—As regards the treatment of this disease, it is extremely simple. The little patient should be confined to bed and have chiefly milk given as a diet. It may be well to administer a saline purge at the commencement. It is said that no fatal case of chicken-pox has been known, but a physician remarks that a child whose temperature may rise from three to six degrees higher than what is natural should be watched with care. Complications in this disease are probably only found in delicate children. To relieve the itching some ointment may be employed. One of the simplest ointments, and one likely to be fairly efficient in preventing irritation. is ordinary boracic acid ointment, which may be freely applied to the skin.

HYDROPHOBIA

Hydrophobia may properly be classed amongst those diseases which are due to the infection of the body by *an animal poison*. In one sense, therefore, it is a disease which presents certain analogies or resemblances to snake-bite, or to such an injury as is represented when a doctor in making a *post mortem* examination accidentally cuts himself and infects his system through some noxious material or other derived from the corpse. The peculiarity of hydrophobia is that it represents a disease liable to be conveyed to man from the bite of a dog, cat, fox, wolf, or other animal which has developed the ailment known as *rabies* or *canine madness*. This disease has been long known to medicine, and was described in its essential features by more than one of the classical writers. The word "hydrophobia" is derived from two Greek words meaning "a fear of water," and this latter characteristic forms one of the principal symptoms of the disease, since the patient certainly exhibits a dread of liquids. The mere sight of a drinking-vessel may produce the spasms characteristic

of the disease, whilst all attempts at swallowing are also rendered futile. The disease of the dog (rabies) probably never arises spontaneously. In other words, as in the case of every other infectious trouble, the dog requires to be inoculated with the poison derived from another dog previously affected. It is not always easy to trace the exact origin of an outbreak of rabies, but one thing is certain, namely, that once introduced into a district a large number of cases may arise through an infected dog or dogs biting others of their species, the danger to human beings under such circumstances being naturally very great.

Although a great outcry has been made in certain quarters against a general muzzling order compelling owners of dogs to muzzle their pets for a certain period, there can be no doubt that one effect of this procedure has been practically to stamp out rabies for the time being. It is highly probable that where, in such a case, a district or country has been entirely free from the disease, no further development of it can be possible, save from a dog imported from some outside source. Acting on this principle the Board of Trade (as regards Great Britain) has carried out the practice that any dog imported from a foreign country must remain in quarantine, and be kept separate from all others under the eye of a veterinary surgeon for a period of some months by way of ensuring that it is in perfect health.

Symptoms in the Dog.—The occurrence of rabies in the dog is marked first of all by a distinct change in the animal's demeanour. It becomes sullen, ill-tempered, and may even attempt to bite its master, whilst it is given to snap at imaginary objects, thus showing a certain amount of brain-disturbance. Another very prominent symptom of this ailment in the dog is found in the fact that its appetite as a rule becomes of a depraved character. It is given to eating all kinds of substances, and where a *post mortem* examination of a rabid dog is made the stomach will generally be found to contain a miscellaneous assortment of articles, among which even stones and cinders may be included. As the disease develops, the nervous symptoms become more and more pronounced. The poison is contained in the saliva or "water" of the dog's mouth. This appears to be secreted in increased quantity in the disease under consideration. If during the prevalence of those symptoms the dog bites another animal, he is liable naturally to inoculate the latter by means of his saliva, when the symptoms seen in the first animal will naturally be reproduced in the one which has been bitten. The rabid dog practically proceeds from bad to worse, and finally dies in a state of exhaustion.

Symptoms in Man.—As regards the symptoms in the human subject, it may be here noted that there appears to be a fair chance of escape from inoculation if the bite is inflicted upon the legs or trunk of the body, inasmuch as these parts being covered by clothing, a considerable chance exists of the dog's saliva being absorbed by the clothes. On unprotected parts, such as the face and hands, there is naturally much greater danger of effective inoculation taking place through the bite. As in the case of lock-jaw, it is, of course, absolutely necessary for infection that there should be a wound, so that the poisonous principle of the dog's saliva should gain admittance to the blood. The skin here, as in the case of lock-jaw, forms, when unbroken, a perfect protection against the entrance of all poisons of this kind to the system. After inoculation there exists a *period of incubation*, for it is not until after a period of weeks, or even months, that actual symptoms begin to develop. The average period may possibly be set down at about six weeks after the reception of the bite. The fact of a period of incubation existing here, would seem to point to the probability of the poison lying dormant in the bitten part for a time, the appearance of active symptoms coinciding with the spread of the poison through the system, and to its specially attacking the nervous system.

It is said that the first sensation experienced by a patient is that of a pricking feeling, or at anyrate uneasiness, being felt at the seat of the wound. It may be mentioned, that the wound may have healed up perfectly, and no apparent trace of disorder left. The nervous system then begins to show symptoms of disturbance. The patient cannot sleep; he is extremely depressed; headaches are present, and his general state may be described as one of extreme restlessness. The feature already mentioned of excitement at the sight of fluids, or on the slightest attempt to swallow fluids, next begins to be apparent. An extreme sensitiveness prevails over the whole body-surface. Spasms are exhibited, especially in the muscles of the neck and body, whilst these spasmodic contractions extend to the limbs. When the paroxysm is at its height, the muscles of the jaws are likewise affected by the spasmodic contraction, and the teeth are brought together with a sharp snap. The patient is also liable to suffer from delusions during the times of his attacks, but between them, as a rule, is perfectly sensible. The saliva greatly increases in amount, and as swallowing is impossible, it is usually ejected freely from the mouth. The breathing is affected through the nervous system, and is of a spasmodic character, the rate of respiration being much increased. The active manifestations of the symptoms do not persist very long. In a typical case two or three days

may bring about a fatal termination, which is marked by general paralysis, lasting for four or five, or even twelve or eighteen hours. Here the patient appears to have acquired a certain amount of ease and rest, but sooner or later he passes into a state of unconsciousness, and finally dies. A typical case of hydrophobia therefore rarely extends over four days, and may terminate at an earlier period.

Treatment.—It will be understood that this disease is a singularly hopeless one, in so far as treatment is concerned. *Local treatment,* in the first instance, cannot be relied upon as an absolute preventive of the onset of hydrophobia, but it is a measure which should on no account be neglected as soon after the bite as possible. The wound must be treated on the principle appropriate to all cases of poisoned wounds. A ligature or tourniquet should be applied tightly to the part, so as to prevent the spread of the poison into the body. The wound must be sucked to remove the poison if possible, and it should be freely cauterised. Possibly the best means of effecting the latter procedure is to use a red-hot iron, otherwise caustics of various kinds in the shape of acids may be used. Pure carbolic acid or nitric acid might be employed to cauterise the bite. The main point to be attended to here is the thorough treatment, not merely of the tissues of the bite, but also those round the bite for a short distance. Medicinal means are largely useless. The doctor will probably inject morphia or chloral by the bowel, or may give chloroform to relieve the spasms. Curare, a drug which paralyses the muscles, has also been employed. It is injected into the skin in a dose of from a twelfth of a grain to half a grain every twenty minutes or every half-hour till the muscular powers are affected.

The Pasteur Treatment.—Physicians to-day are accustomed to rely upon the system of inoculation described by Pasteur for the prevention of hydrophobia. This treatment, it may be mentioned, is only available before the development of the disease. It should therefore be commenced as soon as possible after the infliction of the bite. Cases in which the commencement of this treatment is delayed are usually those which exhibit a fatal issue. People are accustomed in such a case to blame the treatment, when in reality they should lay the result of the fatal issue at the door of the dilatoriness which prevented the patient being attended to at an earlier stage.

In order to understand the nature of this treatment, it is necessary to describe Pasteur's mode of procedure. Part of the brain and spinal cord of an animal which has been affected by rabies is used to inoculate the brain of a rabbit. In this animal the disease develops in about a fortnight. From this rabbit others are successfully inoculated. It is found that the intensity and virulence of the disease increases with

these successful inoculations, until at the end of a certain number of inoculations the rabies is found to develop in the animal in seven days. It is the spinal cords of such rabbits which are used to prepare the material wherewith man is inoculated for the prevention of hydrophobia. The cords are removed from the animals and kept in dry air. As time passes it is found that the activity of the poison in the cords tends to become lessened, so that in this way a series of rabbits' spinal cords, ranging from those presenting extreme degrees of virulence to those of a weak character, are ready for use. Solutions of these cords applied, by inoculation in the dog, protected that animal against the effects of a bite of a rabid companion, and it was after experiments of this kind that Pasteur felt warranted in extending this mode of protection to the human subject.

The first case in which inoculation was used for the cure of hydrophobia happened to be one of a most typical character. This inoculation was effected on the 6th July 1885. A little boy, Joseph Meister of Alsace, was bitten most severely by a rabid wolf, so that it might legitimately be inferred the boy stood the greatest possible chance of death. He was brought to Paris to the Pasteur laboratory, and injections were duly made, beginning with a solution of a very weak cord of the rabbit, and ending in ten days with an injection of a cord which contained the poison in an extremely powerful state. In this case hydrophobia did not develop, and many other cases have been treated successfully in like manner. It should be made an imperative part of the preventive system of medicine in every civilised country that an Institute for the preparation of anti-rabic inoculations should be founded.

The Germ of the Disease.—The actual germ or microbe which may be supposed to be the active agent in the production of the poison of hydrophobia has not been definitely recognised, but the symptoms all point to some form of germ life as the real cause of the affection. It may be mentioned that hydrophobia is most prevalent in Russia, Belgium, and France. Having regard to what has already been said regarding the spread of this disease from one rabid animal to another, we are not surprised to find that islands which were formerly perfectly free from the disease acquired rabies through the introduction of affected dogs. We find examples of this latter occurrence in the case of Mauritius, which was infected in 1813, whilst Malta and Madeira were similarly attacked in 1847 and 1892 respectively. It would appear that the bite of the wolf is much more likely to communicate rabies than that of the dog, this fact being explained in a double sense; first, by supposing that the rabid poison is more virulent in the case of the wild animal, and, secondly, that his bite is generally of a deeper and more severe character.

GLANDERS OR FARCY

This disease presents us with another instance of an ailment which, typically affecting certain lower animals, can be communicated to man. The name *farcy* is often applied to glanders, veterinary surgeons considering that if two diseases are represented the one is merely a modification of the other. Glanders affects the horse, the ass, and the mule, and its human interest arises from the fact that it can be communicated to man by means of the diseased secretions of these animals. The matter which comes from the nose discharges of the animals is regarded as being especially dangerous. The bacillus or germ of the disease is well known. It is a rod-like body; the spore or young form, as in the case of the germ of lock-jaw, being often found at one extremity. Inoculation is no doubt the mode whereby this disease is most frequently communicated. The germs infect the system through gaining admission to the body by means of a wound, a scratch, or a sore of some kind. This disease naturally is found most frequently amongst men employed in stables.

Symptoms.—The period of incubation lasts from three to four or five days. At the seat of the injury or inoculation, swelling occurs whilst the neighbouring glands are found to be enlarged Other symptoms follow in quick succession. The temperature rises, headache is complained of, and pains are experienced in the arms and legs. A characteristic feature of this disease is the formation of abscesses containing "matter" (or *pus*) in various parts of the body. The nose appears to be one of the chief seats of the disease, the discharge from the nostrils being of a particularly foul-smelling and disagreeable description. Ulcers are formed in the throat, and inflammation involves the lungs. Delirium succeeds, and death usually occurs from complete bodily breakdown at a period varying from two to four weeks after the commencement of the ailment.

Treatment.—This disease, like hydrophobia, when it has once laid hold of the system is of a singularly hopeless character. The surgeon will be guided in his treatment of his patient by the general principles of his art. The abscesses or swellings will be opened, whilst disinfectants will be used to the nose, the mouth, and the throat. Such substances as permanganate of potash solution, or salicylic acid, have been recommended for use as disinfectants in this disease, whilst the patient's strength must be supported by a free administration of stimulants. Quinine has also been given in fairly large doses, on the idea of its exercising some antiseptic influence on the blood.

SPLENIC FEVER OR ANTHRAX

These names have been applied to a disease affecting cattle, sheep, horses, and even birds. Like glanders it is transmissible to man, when it receives the names of "Woolsorter's disease" or "Malignant Pustule." The latter variety by many physicians is esteemed to be a modification of true anthrax. The name "woolsorter's disease" was applied to this ailment from the fact that persons engaged in the woollen trade are liable to be infected through the germs of the ailment being contained in the wool they handle. The disease was once fairly common in Bradford and other centres of the wool industry, but owing to precautions taken in the disinfection of wool and to stringent regulations having been passed to this end by Government, the occurrence of this disease has been materially reduced. It is in fact somewhat rare to find cases of this ailment now reported. Anthrax is also liable to occur in men engaged in the work of handling hides, and butchers occasionally fall victims to it.

The Germ.—The germ (*Bacillus anthracis*) is a microbe which has been most thoroughly studied in all aspects of its history. It was very early noted to occur in the blood of infected animals. It would appear that infection, which in man generally takes place from inoculation of the blood with the germ through some scratch or wound, can also take place in animals through the germs of the disease being contained in their food. The spores or young forms of anthrax germs are endowed with a very high degree of vitality. They can retain their powers of infection for long periods outside the body, and may even exist in a dried up state for several years, awakening to renewed vigour, and to the exercise of disease producing powers, when placed in a proper environment. In one well-known case Pasteur proved that an epidemic of this disease, which had not been present in a particular district of France for many years, was due to the infection of cattle and sheep from the bodies of animals which had been deeply buried on the occasion of a preceding epidemic. He showed that earthworms coming in contact with the decaying carcases in the earth had brought the germs to the surface, and the new outbreak was therefore caused by the animals receiving these germs with the grass on which they fed.

With regard to the human side of this disease in addition to woolsorters, horse-hair cleaners, furriers, and others who have to deal with the skins of animals are liable to attack, as also are shepherds and others whose vocation brings them into close contact with cattle. In the history of the disease, as represented in man, we find that,

as already stated, the germs gain admittance probably by a scratch. It is even said that whilst it is very unlikely that man can be infected with anthrax by the lungs, the disease might nevertheless be caused by eating the flesh of an animal which has died of this disease.

Symptoms.—Dealing first with the common variety of the disease, that known as "malignant pustule," the first symptom is found in the appearance of a pustule or pimple of a red colour, which develops in a few days after infection has occurred. This pimple gives rise to what is known as a "vesicle" or small collection of matter, which increases in size and ultimately appears as a dark brown growth, having a thickened base round which a circle of smaller vesicles develop. The glands in the neighbourhood of the part become inflamed and enlarged. From this local source, the system tends to become infected. Fever is present, and the patient experiences extreme weakness. Later on diarrhœa occurs, and he wanders in his mind, death occurring in a few days from complete exhaustion. In the more favourable case (the fatal cases are generally as one to three) the pustule disappears, the wound healing, and the constitutional symptoms gradually vanishing away.

In the second variety of anthrax, which is often known as *internal anthrax*, the skin symptoms mentioned as peculiar to the preceding variety are usually in abeyance. But in the internal variety of the disease we find vomiting, diarrhœa, affected breathing, and final collapse. In connection with this disease the temperature does not as a rule rise markedly. Death may occur within a few days. The lungs also may be affected, the progress of the disease in this region tending to the development of fever and of pneumonia, and allied lung troubles.

Treatment.—There can be little doubt that the first and most effective treatment of "malignant pustule" must be that to be had at the hands of the surgeon. The pustule should be cut out or thoroughly cauterised with some strong caustic, such as nitric acid or caustic potash. The affected part should be kept elevated and completely at rest, whilst ice-bags may be applied by way of reducing the inflammation. Internally, stimulants may be freely ordered, and the food must be of a nutritious character by way of supporting the strength, whilst the use of quinine in adequate doses is also recommended. Ipecacuanha has also been given with success in anthrax, in the shape of the powder. The doses given must be large and frequent.

Prevention.—We have already noted that thorough disinfection of the skins and wool of animals is found to be capable of preventing

attacks of this serious malady. To this should be added the caution that all carcases of animals dying of the disease should be cremated, and not buried in the soil, for the obvious reason that if the spores of the germs are capable of being conveyed to the surface new infections may thus arise. In France and in Germany it is made imperative that such affected carcases should be burned.

It may be mentioned that as a result of Pasteur's researches, he was able to produce an inoculation or serum which, used on healthy animals, was found to be capable of preventing an attack of the disease. The material used for inoculation is prepared by cultivating the germs of anthrax in a particular fashion, so as to reduce their virulence. A series of definite experiments made by Pasteur under the auspices of the French Government finally decided that this inoculation was capable of preventing animals from being attacked, and of thus saving an immense commercial loss to the agriculture of the country. At the present time this system of inoculation for the prevention of anthrax is duly practised in France and elsewhere.

BLOOD POISONING (SEPTICÆMIA)

Whilst the general term "blood poisoning" might be used to indicate all cases in which virulent principles introduced into the blood in the shape of germs or other poisons give rise to definite symptoms mostly marked by constitutional disturbance, fever, and the like, there are nevertheless certain disease phases to which the term in question may be more accurately and definitely applied. The term "septicæmia" is thus often given to cases in which there can be distinctly traced an infection probably due not so much to actual germs as to the poisonous principles called *toxins*, to which such germs give origin. The result of this infection is to produce a general diseased condition of the body at large, presenting us with fever, prostration, a dry tongue, an enfeebled heart, and a general low, or as physicians sometimes call it, "asthenic," state of the whole system.

Pyæmia.—Under the head of pyæmia, another phase of blood poisoning has been recognised by physicians. Here it is believed that two well-known germs, which are found to be associated with the development of *matter* or *pus*, play the part of exciting agents. As a result of pyæmia, collections of matter or abscesses may be found in various parts of the body. The bag of the heart (or *pericardium*), the lining membrane of the abdomen (*peritoneum*), and the *pleura* or lining membrane of the chest are thus liable to be affected. In connection with blood poisoning of this kind, the characteristic fever

appears to be associated with a high temperature ranging from 102 to 104 degrees F. A premonitory symptom is that of shivering, and this may be followed by profuse discharge from the skin. The fever rises and falls, exhibiting sometimes an interval of a day between the rises. Vomiting may occur, and the spleen is frequently found to be enlarged. Jaundice is not an uncommon symptom, more especially where the liver may be affected by abscesses. In a serious case of this nature the patient gradually loses strength and dies in a state of unconsciousness and collapse.

Treatment.—Such diseases, which, by the way, may follow surgical operations, can only be treated on general principles. In all probability the most successful modes of treatment are those which can directly attack the origin and the seat of the disease, presuming that this latter can be easily reached by the surgeon's art. For the rest, treatment must be conducted on the general lines already indicated in dealing with other cases of the nature of blood-poisoning. The patient's strength must be maintained by every means at hand. Nourishment must be freely given with plenty of stimulants. The use of quinine here, as in the case of the diseases previously considered, is also to be commended.

TUBERCULOSIS

It need hardly be remarked that the ailment known as *tuberculosis* has assumed a very important position not merely in the eye of the physician, but also in that of the sanitarian. In the one case the physician is concerned, as we know, with the cure of the ailment. The sanitarian, however, concerns himself with a no less important work, that of prevention. In order at the outset clearly to understand the significance of tuberculosis we may first of all note that the term is applied to *a general disease* which is practically found to affect almost every organ of the body. In this sense it is an ailment which might be ranked with scrofula itself, with which, indeed, as has been shown when dealing with that type, tuberculosis possesses certain intimate relations. By the public the term "tuberculosis" is generally regarded as being synonymous with "consumption." It is important therefore to note the relationship which exists between these terms, and more especially that which expresses the nature of the diseases they indicate. Briefly stated, if tuberculosis be regarded as a general disease liable to affect the body at large, the ailment we term *consumption* or *phthisis* is simply *tuberculosis of the lungs.* By way of citing another example in illustration of the

meaning of the names already indicated, we may note that when a mother speaks of her child being afflicted with "consumption of the bowels," she means to indicate that certain glands connected with the absorption of food from the intestines have become affected by the bacilli or germs of tuberculosis, which in this way produce the symptoms of wasting characteristic of this infantile trouble.

It will be understood that the subject of *consumption* or *phthisis* will be duly treated under its proper head, namely, under diseases of the breathing organs. In the present instance we have to discuss the characteristics of tuberculosis viewed as a general disease.

Its Nature.—Tuberculosis naturally falls for consideration in the present section of this work, because it is undoubtedly an infectious disease. It owes its origin to the presence of a special germ or microbe known as the *Bacillus tuberculosis.* This bacillus was discovered by Dr. Robert Koch in 1882. His work was the result of a long series of very important researches, which had for their object the isolation and separation of the particular bacillus or germ which we now know is invariably found when tuberculosis is present. The bacillus appears before us as a short rod-like germ, which attains a usual length of from one-quarter to one-half the diameter of a red blood corpuscle. The average diameter of such a corpuscle in man's blood is about the one three-thousandth part of an inch. The ends of this bacillus are of somewhat rounded or pointed shape. Very frequently these germs are found to exhibit somewhat of a curved outline, or even may be somewhat spiral in character. It was formerly supposed that an appearance of beading in these germs indicated the development of the "spores" or young stage of the future germs. This idea is not, however, now entertained, inasmuch as the tubercle bacillus is capable of being killed by a degree of heat which is much lower than that we know to be required for the destruction of spores. When the bacillus was first discovered it was assumed that tuberculosis in man and in cattle was due to infection by one and the same germ. Recent investigations, however, render it extremely probable that there exists a difference between the microbe found in cattle and that associated with man's ailment. Thus it is stated that the bacillus of cattle is shorter than that found in human tuberculosis, and does not measure more than quarter the diameter of the human red blood corpuscle. The bacilli obtained from cattle are also thicker than the human bacillus, and the beaded appearance already mentioned as characteristic of the bacillus of man is absent. The importance of considering tuberculosis in lower animals is obvious, seeing that especially in the case of a cow whose udder is affected by tuberculosis, a liability must exist of conveying the disease

to human beings through infection by means of the milk. Birds are also subject to the attack of tuberculosis. Chickens for example have been infected through picking up and swallowing the matter which has been brought up from the lungs of a consumptive patient. In one well-known case fifty hens died of tuberculosis in from three to four months. The mortality amongst the hens commenced a few weeks after the arrival of a consumptive patient in a house near which or at which the fowls were kept. In a well-known French case a number of chickens belonging to a family, one member of which was suffering from consumption, developed tubercle and had to be destroyed. Parrots have also been noted to acquire tuberculosis, probably from association with human beings, and it is noted that in some fishes, and particularly in the carp, a disease of this kind has been found. In this case infection was believed to have taken place through tubercular matter from human beings having gained admittance to the water in which the fishes were kept.

The Relations of the Disease in Man and Animals.— We may here refer to a topic which for some years past has excited a very large amount of interest amongst physicians and sanitarians at large. This subject really focusses itself around the question whether or not man is liable to be infected with tuberculosis from lower animals and specially from the cow. At the Congress on Tuberculosis held in London in 1901, Koch himself maintained that human tuberculosis was not that found in cattle, and that the disease cannot be transmitted from cattle to man. From this he drew the conclusion "that the extent of infection by the milk and flesh of tuberculous cattle and the butter made from their milk is hardly greater than that of hereditary transmission, and that it is inadvisable to take any measures against it." This declaration was received with what may be called feelings of consternation on the part of the medical world, for a doctrine which had been most assiduously preached was that of the necessity of boiling or sterilising the milk on which infants are fed by way of destroying the bacilli contained in the milk of cows with affected udders, and thus preventing direct infection of the infant through its digestive system. Koch certainly showed that in the case of cattle which had been proved to be absolutely free from tuberculosis, inoculation of the animals with tubercular matter from man (and also the administration of such matter in their food) produced no result whatever save that at the point of inoculation insignificant abscesses were found. On the other hand tuberculous matter taken from cattle and used to inoculate other and healthy animals invariably conveyed disease to the animals. Dogs fed on tuberculous matter obtained from man exhibited slight signs of infection, but when they

were treated with material derived from cattle they invariably developed the disease.

Opposed to this view we find a considerable body of opinion founded upon experiments which are still in progress. It has, indeed, been shown that inoculation of pure human bacilli may produce tuberculosis in cattle, whilst even the matter coughed up from human lungs and containing bacilli has been known to be followed by a development of the disease in cows.

Infection.—Turning to the question which is that mainly concerning human health, whether tuberculosis of the cow can produce the disease in man, we have seen that Koch denies the possibility of this occurrence, or at least assumes that it is extremely rare and uncommon. Three modes of possible infection by tuberculosis have been recognised by physicians. First and foremost there can be little doubt that as regards infection of man by man the bacilli are inhaled into the lungs, and therein develop consumption. This may be called *direct infection.* The second mode of infection is that by means of *tuberculous milk*—that is to say, milk derived from a cow the udder of which is affected. The third possible mode of infection is that attributed to *tuberculous meat*—that is, to the consumption by man of the flesh of an animal suffering from tuberculosis. It may here be added that a cow may suffer from tuberculosis, and her udder nevertheless be free from the disease. Only a certain proportion of cows exhibit the disease in such a state as to show actual infection of the udder and milk.

It was an argument used by Koch that if the bacilli of bovine tuberculosis were ever capable of affecting human beings, many cases of tuberculosis, caused by the consumption of aliment containing tubercle bacilli, should be found among the inhabitants of a great city, and especially among young children fed on milk. He contends that this is not the case. The argument here is that if tubercle bacilli contained in the milk of cows were capable of conveying the disease to children, a very much larger proportion of cases would be found in which actual infection from the *digestive system* could be traced. In support of his views Koch quoted the fact that in Berlin only a small percentage of children dying of tuberculosis could be proved to be thus infected, his argument being that if infection were conveyed through milk a much larger number of cases should be recorded. Whilst this view may be true for Berlin, it is certainly not correct when applied to the case of London, Edinburgh, and other large British centres. The real explanation of the comparative freedom of German children from infection by milk as compared with the apparently larger amount of such

infection present in Britain and other countries, is probably explained by the fact that the German mother is more careful in boiling and sterilising the milk on which her children are fed than are mothers of other countries. In concluding this highly technical and debateable topic which, as we have shown, is still being made the subject of extensive experimentation, the opinion may be expressed that until the most satisfying evidence can be afforded of the impossibility of infection by means of tuberculous milk, none of the precautions hitherto advised by medical men in respect of boiling and sterilising milk should be neglected.

Tuberculous Meat.—With regard to the other modes of infection, that represented by *tubercular meat* is not perhaps so commonly represented in our midst, this probably for the reason that the meat is cooked before it is consumed, and a fairly low degree of temperature, as we have seen, serves to kill the bacilli. Experiments have shown, however, that the thorough cooking of the outside of a joint of tuberculous meat may not suffice to kill the bacilli contained in the interior. The remedy against any possible infection of this kind is, however, clear enough. Rigid inspection of slaughter-houses and of the meat which is exposed for sale, should suffice to reduce the possibility of infection from this latter source to a degree which renders it probably hardly worth consideration.

Inheritance.—From what has been said it is obvious that tuberculosis in one way or another is an infectious disease, and we may lay down as representing a distinct law relative to this ailment the statement that a case of tuberculosis which presents itself in a child or an adult is as typically to be regarded as a case of infection by germs, as say a case of typhoid fever, scarlet fever, small-pox, or other contagious trouble. The latter view undoubtedly opposes itself very directly to the older conceptions of this disease. The part played by *inheritance* was formerly supposed to be of an extremely powerful and decided kind. The child born of tuberculous parents was considered to be already infected. In other words, it was believed to inherit a direct legacy of the disease from its father or mother, or both. To-day we do not believe in any such direct transmission of the ailment. We fall back here upon that very useful conception applying to all diseases, namely, the idea of "the soil and the seed." Most physicians incline to the belief that the condition represented in the child of tuberculous parents is not that of ready-made infection before birth, but simply a greater liability or tendency on the part of his body to be infected by the germs of the disease than is represented in the case of a child born of a healthy parentage. In other words, the child of tuberculous parents, whilst not exhibiting any signs of the disease as the result

of heredity, possesses less resistance or exhibits a less degree of resistant power against the attack of the germs than does the healthy child. This doctrine is of a cheering nature, inasmuch as it teaches us as its practical outcome that if the child of tuberculous parents be carefully attended to in its earlier years in the matter of nourishment, clothing, fresh air, and other conditions of health, his expectation of life and of freedom from the disease will be equal to that of the child of healthy persons.

How Tuberculosis is Conveyed.—We have seen that the main source of infection from tuberculosis is undoubtedly that whereby the germs of the disease brought up from consumptive lungs are conveyed to the lungs or other organs of a certain proportion of persons in whom they find an appropriate soil and breeding-place, A consumptive man will cough up as many as *twenty millions* of bacilli per day. So long as this coughed-up matter remains in a moist state little danger is to be apprehended from it in the way of infection, but when this *sputum* (or coughed-up matter) dries, the bacilli then escape into the air, mingle with the floating dust of the atmosphere, and are liable to be inhaled by the population at large. Hence, as will be shown in the section dealing specially with consumption and its treatment, the important advice which teaches that all coughed-up matter should be received into special vessels and should be efficiently disinfected, ought to be clearly borne in mind. If this practice were universally observed, we should find a marked diminution in tubercle-infection. It may be added that this disease, which in past years has been responsible for such a tremendous mortality, now shows signs of diminution, a result no doubt due to the education of the people in the nature of the ailment and in the means to be adopted for its prevention.

Symptoms.—When the germs of tuberculosis invade the human body it would appear that they tend to set up a slow form of inflammation characterised by a considerable increase of the natural cells of the tissues which the germs have invaded. In this way is formed a mass or nodule of a hard consistence and of a grey colour. Its average size is that of a mustard seed. This mass is called a *tubercular nodule.* Later on the mass undergoes certain further developments. The cells already alluded to grow together, or at least form what are known as *giant cells.* Later on the nodule appears to undergo a species of degeneration. It may unite with others, and the substance of the mass breaks down into matter of a cheesy consistence. From this latter fact the process has been called one of *caseous degeneration.* At this stage the infection of other parts of the body is liable to occur, for the tubercular matter or microbes, absorbed by the lymphatic vessels or by the blood-vessels, is carried

to other and distant regions of the body, there to give rise to fresh nodules. If, on the other hand, a favourable termination takes place, a process of healing is witnessed. Instead of breaking down and forming a mass of cheesy consistence, the tendency then is to develop what is known as fibrous tissue. This latter process in a rough way might be compared to the development of similar tissue we see in the scar or cicatrix represented in the healing of a severe cut or wound. In such a case the lung or other tissue remains permanently altered after the tubercle has healed, as the skin tissue is altered in the wound scar.

Progress of Tubercle.—We find an excellent illustration of this mode of the healing of tuberculosis in the case of the lung of a person who has recovered from the disease. It is no uncommon thing to find in the lungs of persons who have died of other diseases, small patches of a fibrous nature indicating places where tubercle once existed, but where also the process of healing has been perfectly accomplished. The knowledge of this fact teaches us therefore that tuberculosis, so far from being necessarily a fatal disease, is one which nature herself makes very definite and strong attempts to cure. It may be mentioned in this connection that all efforts in the way of open-air treatment, good feeding, and the like, intended to brace up and improve the general condition of the patient, must directly affect the healing of tubercle by rendering the soil, so to speak, less fitted for the continued development of the tubercular seed.

Prevention and Cure.—Tuberculosis is practically a disease of early life and of adult life. It is not an ailment that is specially developed in later adult life or in the aged. It would appear that *sex* does not markedly influence the onset of the disease, both sexes being apparently liable to what may be termed an equal risk of infection. Whilst the influence of *heredity*, as we have shown, has been discountenanced of late years in the matter of tuberculosis development, it may nevertheless be noted that a far greater risk of the development of tubercle is seen in cases where an absolute delicacy of body forms an individual feature of the earlier stages of life. In this connection it may be borne in mind that as scrofula and tuberculosis are diseases which are seen to be very closely related and to be probably caused by the same germ (or a nearly related species), we can well understand how a child born of scrofulous parents and exhibiting the features of scrofula will be an extremely likely subject for the development of tubercle. The precautions already mentioned as being necessary in the case of delicate children at large by way of building up their constitutions are those which in the case of scrofulous children especially, should be rigidly attended to by way of warding off possible infection.

Occupation and Tubercle.—In connection with the development of tubercular disease, especially of the lungs, it may be noted that certain trades have acquired an unenviable notoriety from their influence in producing such deterioration of the health of the workers that infection is rendered extremely probable. All trades in which the workers are compelled to breathe *dusts* of various kinds may be cited as examples in point. These dusts may be represented by steel dust, stone dust, flax dust, and the like. Their inhalation, whilst not of itself capable of conveying tubercle, nevertheless prepares the soil for the seed, and produces lung troubles and irritation of various kinds, such as undoubtedly pave the way for ready infection by the bacillus. It may also be added that as regards other external conditions favouring the onset of tuberculosis the bad ventilation of rooms, overcrowding, poverty, and the like must be also prominently taken into account.

Preventive Measures.—Turning to the question of the treatment of tuberculosis, we have already indicated in passing many of the precautions which may be taken by way of limiting the chances of attack. The inspection of dairies, the boiling of milk, the weeding out of the carcases of tuberculous animals so that they shall not be sold as food, the disinfection of all coughed-up matter from the lungs of consumptive patients, the prohibition (operative in many places) of spitting in the public streets and in public vehicles—all represent measures calculated to stay what has been called the modern "white plague." It is of importance also to note that in all probability the marriage of persons coming from a tubercular stock should be prohibited. Such unions are extremely ill-advised, inasmuch as while there may be no actual transmission of the disease, they are apt to result in the breeding of a weakly stock that is more liable to succumb to the risks of infection.

Treatment.—The treatment of general tuberculosis may be summed up in one word, namely, the encouragement of a thoroughly healthy state of the body. This aim is naturally attained by attention to all the conditions which make for health at large. Purity of air and of the general surroundings, appropriate food, containing a sufficiency of fat above all things; warm clothing, guarding against chills, and seeing that in the case of children especially, no educational overwork is permitted, form important points in connection with the treatment of this disease. The administration of cod liver oil or Virol after meals forms an important element in the treatment of this and other degenerative diseases. In a word, while we increase the resistent power of the body against attack, we are at the same time practically curing the disease. In this connection the *open-air treat-*

ment of consumption, the most notable form of tuberculosis with which we come in contact, has itself exerted a considerable amount of influence upon public opinion in the matter of showing that purity of air and good feeding form the sheet-anchors of treatment, simply because these measures constitute the base and foundation of conditions tending to give the body a greater power of resisting germ attack.

MUMPS

This is a disease apparently common to all parts of the civilised world, and liable frequently to break out in epidemic form. It appears to occur most commonly in cold and damp weather, and is not uncommonly associated with an attack of scarlet fever and with epidemics of measles. These epidemics of mumps are usually separated by a considerable period of years. The duration of mumps as far as its active state may be concerned may be said to last for a period of four or five days or longer. The period of incubation of this disease varies very much, and probably lasts from comparatively few days to, it may be, some weeks. One attack appears usually to protect against another. The infection of mumps is conveyed chiefly by means of the breath and probably through the secretions of the mouth as well.

The period of quarantine after recovery from this disease will extend to about three weeks, and the same period may be held to be necessary in the case of a person who has been exposed to infection by way of ensuring whether he is to fall a victim to attack or not.

As is well known, the chief seat of the attacks of mumps is one of the salivary glands of the mouth. This is known as the parotid gland. It is situated in front of the ear, and represents the largest of the salivary glands, of which three pairs exist.

The most common age for attack is between four and twelve years. The symptoms consist first in a pain generally felt in one ear, whilst the neck and the jaw are sore and stiff. The swelling, beginning at first in front of the ear, may extend so as to involve the other salivary glands situated in the floor of the mouth. In a couple of days or so the other side of the head will be affected, causing well-marked swelling in this region. In addition, we find that swallowing becomes very painful, whilst all movements of the mouth are performed with difficulty. The fever tends rapidly to disappear along with the swelling.

Metastasis.—A very curious feature of mumps is the possible transference of this disease to other organs of the body. This principle has already been described under the name of *metastasis.* Thus

we may find at a late stage in mumps, swelling of the breasts in a female child or of the testicles in a male child, whilst it is not uncommon to find in female children discharges from the genital organs. More rarely are brain troubles seen in the case of this ailment.

Treatment.—For the *treatment* of mumps, warm poultices should be applied to the affected parts, whilst a saline purge should be given early in the course of the disease, and repeated if necessary. It is recommended that through the course of this disease one-third of a grain of calomel should be administered once or twice a day.

Throughout mumps, indeed, the importance of attending to the bowels is a point insisted upon by all physicians. If pain exists in the swollen glands, a liniment composed of equal parts of glycerine and extract of belladonna may be smeared over the affected parts. Where the disease shows a tendency to pass to other organs, as has already been explained, a mustard poultice should be applied to the *parotid gland*, by way of inducing the inflammation to return to its original seat, whilst a warm bath may be given or the feet be placed in hot water and mustard. If this process of the transference of the disease to another organ is threatened during convalescence, tonics should be employed. Iron and cod liver oil is a favourite combination with physicians by way of bracing up the child's system.

The medical name given to mumps, it may be added, is *Cynanche Parotidea.*

DYSENTERY OR "BLOODY FLUX"

This is a disease more commonly found in tropical countries than in Britain. It appears to be endemic in hot regions, whilst it is liable to acquire an epidemic character also in such latitudes. *The cause* of this disease has been referred to a microbe, which, however, unlike that associated with other diseases, appears to belong to the animal kingdom. Amongst the lower orders of animal life we find certain animalculæ, each consisting of a speck or protaplasm or living matter capable of active movements of its substance, and found in stagnant waters. Such an animalculæ is known as an *Amœba* (Fig. 34, A). Dysentery is believed to be due to the presence in the intestine or bowel of man of an organism of this character, and such microbes have been found in the bowel-discharges of patients as well as in abscess of the liver, which latter ailment is apt to result in the case of this disease.

Infection.—Dysentery is not regarded as a contagious disease. It probably arises from the drinking of infected water, but if this view be correct the infection of the water can only arise from the escape

into it of the bowel-discharges of dysenteric patients. Hence it forms a matter of importance that these discharges should be duly disinfected. This precaution may well be regarded, at least, as a possible means of prevention of the disease.

Its Seat.—Dysentery affects the *large bowel* chiefly. It may be here mentioned that the length of the bowel or intestine in man is twenty-six feet. Of this length twenty feet form the small intestine which immediately succeeds the stomach, the remainder forming the large intestine. The concluding portion of the large intestine (ending at the anus) is called the rectum, and this ailment specially affects this latter portion of the bowel, although the inflammation may extend further up the intestine and even attack the lower part of the small bowel itself. When dysentery affects persons resident in tropical climates, the liver often exhibits the abscesses already mentioned, whilst the spleen is extremely liable to be enlarged and to undergo degenerative changes. It would also appear that secondary symptoms are also liable occasionally to affect the lungs. One of the main features of this disease is the tendency of dysentery to become of a *chronic nature*, and persons who have suffered from the disease abroad and who return home to Britain may be therefore more or less invalided from the chronic and lasting condition which this disease tends to assume.

Symptoms. — The first symptoms of dysentery are those of *diarrhœa.* Previously to the occurrence of this symptom the bowels may have exhibited a constipated condition, or there may have been present irregular bowel-action at large. After an incubation period, varying from three to five days, diarrhœa sets in. This is accompanied by a certain amount of fever with shivering, and as a rule *the first attack is experienced during the night.* There is severe pain in the belly. No sooner has one motion been passed than the patient feels a desire again to evacuate. When the bowels have been evacuated straining results with pain, and the matter ultimately passed consists of little more than *mucus* (or *secretion of the intestine*), mingled with blood. Mixed up with the bowel motions are small whitish-looking masses, which physicians have compared in appearance to boiled sago or the spawn of frogs.

Its Course.—This attack may last from six to eight days, the patient feeling worse at night. In a fatal case these symptoms continue, causing tremendous depression of the patient with ultimate collapse. If improvement results, the fever gradually disappears, whilst the bowel motions become less frequent and of more natural character. The disease lasts for a period of about three weeks, but may in severe cases extend to two months. The eighth or ninth day

of this disease must be regarded as indicating the grave period when improved results or a fatal issue occurs. Certain variations in the type of this disease are noted by physicians, and what is called a typhoid condition, where there is general collapse with symptoms indicating extreme prostration, may be frequently represented.

Treatment.—The treatment of an ordinary acute attack of dysentery may be said to begin with attention to all the surroundings of the patient, and especially with regard to the care of all food as regards its cleanliness, and also with regard to the water-supply. It would be well in neighbourhoods where dysentery is prevalent that all drinking water be boiled before being used, or a *Berkefeld Filter* be used. All kinds of vegetable matter should be thoroughly washed as a means of prevention.

Diet.—The diet in this disease should be limited to strong soups, milk, and the like. Vegetable food as a rule should be avoided, with the exception probably of stewed apples. The abdomen should be protected by a warm bandage of flannel. If any constipation exists, a dose of compound rhubarb powder may be taken. The patient is to be kept warm in a well-ventilated room. *Rest* is an important point in connection with this trouble.

A Specific.—The great remedy for dysentery is ipecacuanha. In this disease the drug may be considered a specific. In treating a case of ordinary acute dysentery, the bowels are first of all to be cleared by giving an injection of tepid water. Three pints of tepid water may be used for this purpose. Next a dose of ipecacuanha should be given. This should consist of thirty grains of the powder, ten grains of bicarbonate of soda with half an ounce of syrup of orange-peel being added to it. If vomiting occurs the draught should be repeated. The direction must be thoroughly observed that perfect quiet on the part of the patient is necessary. After receiving the draught for three hours at least no fluid whatever must be taken. After the expiration of eight to ten hours, twenty grains of the powder should be given. Thereafter fifteen grains may be given once a day for some days. Later on, when the active symptoms have disappeared, a dose of ten grains of the powder should be given at bedtime for one or two days. Profuse perspiration will probably be induced by the ipecacuanha. If this is the case, care should be taken to see that the patient does not suffer from chill.

Another mode of treatment which has been much practised, especially in the earlier stages of dysentery, is that of giving sulphate of magnesia, otherwise known as *Epsom salts*. The mode adopted is that of taking a saturated solution of the substance made with seven ounces of water, adding one ounce of dilute sulphuric acid. Of this

mixture a dessert-spoonful may be given every two hours until the character of the bowel motions have altered, and until the fever and the pain have become lessened. Thereafter a dose of ipecacuanha may be given, or a few drops of tincture of opium in a dose of castor oil.

Another remedy which has been employed by some physicians in the treatment of dysentery where ipecacuanha is not well borne, is that of administering fifteen grains of salol, or three tabloids of five grains each crushed and dissolved in milk twice or thrice a day.

This latter plan is, however, inferior to the treatment by means of ipecacuanha in acute cases

CHRONIC DYSENTERY

Where dysentery disease tends to become chronic, and where the patient is liable to suffer more or less frequently from attack, a different mode of treatment is of course to be adopted.

The diet should be carefully supervised. Any excess of vegetable matters should be avoided, and, indeed, great care should be taken by the patient in seeing he only takes such vegetable food as may be found to agree with him. It will be well that warmth be applied to the abdomen by means of a flannel bandage or abdominal belt. If active symptoms are developed, ten grains of ipecacuanha may be taken. Sub-nitrate of bismuth is also regarded as of value here, whilst the salol treatment may be tried in chronic cases if other means fail. Dover's powder taken in a dose of ten grains at bed-time has also been found to act excellently in many cases. In some instances physicians prescribe injections of starch and opium. *Rest* is of extreme importance in the treatment of this disease, seeing that in a recumbent position the movement of the intestine is limited.

The food, it may be added, should consist of soups, milk (having lime water added to it), while egg flip, with a little sherry or brandy added, will also be available. As regards *meats*, these should be rather limited to chicken and mutton than to the more indigestible varieties.

In chronic cases also the liquor of the pernitrate of iron has been recommended, especially in those persons who return from tropical climates. The dose is thirty minims every six hours, taken in plenty of water. In some cases ten minims are given, well diluted, every hour for six hours, when the ailment is troublesome. Citrate of iron and quinine mixture is often found to act favourably in addition. Those who can afford a residence at foreign spas may be recommended to try Marienbad, Spa, or Tarasp.

YELLOW FEVER

Yellow Fever, as has been already remarked, is a disease confined to tropical climates and also to those which have been named subtropical. In former days the fever was regarded as presenting certain close points of resemblance to *malarial fever*. By physicians to-day, however, yellow fever is regarded as showing a more intimate relationship to such an ailment as cholera. In the West Indies and West African coasts this fever may be regarded as *endemic*. It constitutes a veritable scourge in such localities. In America epidemics of this fever occur between points practically represented by Charlestown in the north and Rio de Janeiro in the south. Very rarely indeed have cases of this fever been found in temperate climates, although there is a record of cases occurring at Swansea in Great Britain in 1864. Here infection arose apparently from germs conveyed by sea, for those who fell victims to attack were engaged in vessels coming from infected places. As a rule, however, an infected ship seems to lose the power of propagating this ailment when it passes into a temperate climate.

Conditions.—Yellow fever is most prevalent between the months of April and September in the West Indies and West Africa, but in other places epidemics may occur from July or August onwards to the close of the year. It is essentially a disease of low-lying lands, and it is said in the West Indies that attack is unknown above 1700 feet over sea-level. As in the case of cholera, the occurrence of yellow fever appears to be favoured by insanitary surroundings. Where the air, water-supply, and soil are polluted—or, in other words, where a filthy environment and overcrowding are represented—the fever tends to develop. It is curious to note that certain races appear to be entirely incapable of receiving infection from this ailment. The negro as a rule escapes, whilst the Chinese have also been regarded as exhibiting an immunity or freedom from attack. It need hardly be said that Europeans or Americans coming from temperate climates into endemic districts frequently fall victims. It has also been noticed that if negroes are removed from situations in which yellow fever is prevalent, they are apt to lose their protective power, so that they are liable to be seized on their return to an affected area. Also it has been noted that white persons coming from temperate climates may acquire a certain degree of protection from attack, but this result probably arises from the fact that they have undergone an experience of the disease. One attack of this disease seems to protect against another seizure.

The germ of yellow fever has been variously described. One microbe or bacillus has been isolated, and is generally regarded as the cause of the ailment. Another and different microbe, which has also been considered as a probable cause of this fever, has been found in the earth of graveyards in which the bodies of persons dying from this ailment have been interred.

Infection.—Infection may no doubt be conveyed directly by persons who have been in close contact with cases of the disease or by infected clothing. A curious fact regarding yellow fever is its greater liability to attack persons in good health, men being more frequently infected than women. If, as has already been remarked, this fever shows intimate relations to cholera itself, the matters brought up from the stomach and also the bowel discharges may be looked upon with great suspicion as probably media for the conveyance of infection.

Symptoms.—The period of infection in this disease varies from two to three days onwards to a fortnight. The degree, however, on the side of shortness, extends to a period of twenty-four hours only. The onset of the fever is of sudden nature, and it most frequently attacks the subject during the night. Intense headache, with pains in the back and spine, and vomiting are the prominent preliminary symptoms. The temperature also rapidly rises with the development of the fever, rising to 104.5°. A marked feature of this disease is that of *incessant vomiting*, blood sooner or later appearing among the matters brought up. Another equally prominent symptom of the disease is the development of *jaundice*. The whites of the eyes develop a characteristic yellow tint, whilst the yellow colour spreads over the body at large. The kidneys are also affected, and when the urine is examined it is found to contain albumen. The quantity passed is much diminished, whilst the secretion of the kidneys may be altogether suppressed. The fourth day seems to be a critical one in connection with yellow fever. If the temperature falls about this period the probability is that recovery will take place. There is no marked *crisis* in this fever, however, the change from the feverish state being gradually accomplished. The period of convalescence is set down at from two to three weeks. In fatal cases the temperature is maintained, and a very significant and grave sign is that known as *black vomiting*. The appearance in question is largely due to the presence of blood which has been effused into the stomach. In this disease also the kidneys may exhibit hæmorrhage seen in the urine, whilst bleeding spots may also appear under the skin. The mortality from this disease is very great, and has been set down as one in every three cases. With reference to the effects which the microbe of this fever may be said to produce on the body, these are marked by serious

derangement of the liver, and a process of fatty degeneration is believed to take place in that organ. The poison engendered by the microbes is believed to show a distinct effect in the shape of the destruction of the red corpuscles of the blood. It is this effect on the blood which probably renders convalescence from yellow fever a long and tedious matter.

Treatment.—With reference to the treatment of this disease, the practice which applies to the case of typhoid fever likewise may be borne in mind here, namely, the importance of the patient taking early to bed. Treatment has not been extremely satisfactory up to the present time, and therefore it is not surprising to find that many and varied remedies have been tried.

Probably the safest plan is for the patient to go to bed, to take warm drinks, to sleep between the blankets, and thus to encourage very free action of the skin. It is of importance that the bowels should be first cleared, and by the administration of a dose of castor oil. For the vomiting small pieces of ice may be given the patient to suck. In yellow fever stimulants are freely administered in the shape of champagne or brandy and soda iced, whilst iced milk with soda or barley water may also be given to alleviate thirst. In this disease, as in the case of typhoid fever, it is important to give no solid food during the progress of the disease, and a return to a solid diet should be very cautiously made. During convalescence a tonic of citrate of iron and quinine should be given.

One authority says that if a dose of calomel (say five grains) be given, to be followed immediately by one or two full doses of quinine during the first twenty-four hours of this fever, the temperature may be made to fall, and a favourable influence be exerted on the course of the disease; but calomel or any form of mercurial treatment should not be administered, it is added, later than the second day of the fever. In this disease it is *wise to avoid the administration of opium.* If black vomiting should appear, ice may be given internally, and ice-bags applied over the stomach. By way of disinfection of the intestine, twenty grains of sulpho-carbolate of soda, dissolved in water, have been given every three or four hours. The authority from whom we have already quoted mentions that a certain plan of treatment was followed out by him in connection with an epidemic of this fever. He first ordered an emetic of ipecacuanha, by way of emptying the stomach, then a powder containing from ten to twenty grains each of calomel and quinine was given, followed by a full dose of castor oil. Hot mustard foot baths were also ordered by way of exciting skin action, and cold water was given as a drink to stimulate the functions of the kidneys, care being taken that no chill was sustained. Barley water

formed the only nourishment of the patient during the high stage of the fever. In the case of a high temperature at the beginning of this disease five to ten grains of tincture of gelseminum were given every two or four hours.

DENGUE

Dengue is a curious ailment found chiefly on the East Coast of Africa; it also occurs in British India, and is found in the West Indies and in the Southern States of America. This disease, also known as *dandy fever*, as *break bone fever*, and as *third day fever*, was first clearly recognised in 1824 in the course of Indian outbreaks. Epidemics of this disease seem to be separated from one another by long periods of years, but there can be little doubt that it is infectious, and seems to spread along lines of human communication. It appears to exhibit a certain relation to heat as an external condition. Abroad, most frequently, it occurs in the hot season of the year, whilst its progress appears to be arrested by cold. This ailment is chiefly found in towns situated on the sea coast, and as in the case of yellow fever, the prevalence of insanitary conditions appears to promote attack. In certain of its features dengue suggests a resemblance to influenza itself, and some authorities are inclined to regard it as a variety of the latter complaint, modified by conditions amongst which those of climate are regarded as the most important.

Incubation Symptoms.—The period of incubation in dengue seems to extend to two or three days only, and the ailment begins with a rise of temperature. Shivering occurs, but a more interesting and definite symptom is that noted in the pains which are found in the muscles and small joints of the hands and feet, whilst at a later stage such pain appears to affect the body at large. The joints undergo swelling, and a peculiar eruption, consisting of inflamed patches, appears in the face, which becomes swollen and exhibits a dropsical appearance. The rash, consisting of red spots of irregular outline, first appears on the face about the fifth day, and later on extends over the body. For forty-eight hours the fever may run high, then after one or two days the active symptoms cease, the termination of the fever so far being marked by profuse sweating. The secretion of the skin here, as in the case of rheumatic fever, develops a peculiar odour. About the fourth day the patient is liable to a return of the fever and to a relapse. There will be at this stage some swelling of the glands of the head and neck, whilst throat symptoms are also noted to occur.

By the sixth day the disease as a rule reaches its height, then on

the seventh or eighth day skin peeling is usually seen, a feature which suggests a likeness in this respect to scarlet fever itself. The disease appears to be fatal only in weak persons, in the very young, or in the extremely old.

Treatment.—The treatment of dengue is generally regarded as of simple character. Begin by administering a saline purge, so as to secure adequate movement of the bowels. Relying on the idea that this disease exhibits some likeness to malarial fever in its type, quinine should be given in doses of five grains. For the rest, this treatment will probably control the fever. In the latter stage of treatment the remedy most frequently prescribed is iodide of potassium. A dose of this medicine varies from four to five grains in water, given three times a day, or it may be added to any vegetable infusion. If the temperature remains from 105° to 107° cold sponging should be practised by way of reducing the fever.

Belladonna has also been prescribed with success. The dose of the tincture is from ten to fifteen drops, and when the fever runs high a dose of this amount given at intervals of an hour, up to three doses, is said to exercise an excellent effect. If there is much restlessness with deficient skin action, a ten-grain Dover's powder may be given to promote free perspiration.

MALARIAL FEVERS

Under this term are grouped together more than one variety of a common disease, the leading characteristic of which, as regards its causation, appears to be its association with a certain type of soil. This type, known as a *malarial* (or *malarious*) *soil*, may be described as one typically represented by marshy and swampy areas, the chief feature of which is the presence of quantities of decaying vegetation. It is believed that amongst such surroundings the germs of the disease may breed and multiply, but as we shall presently note, the mode in which these germs are transmitted to the human subject is of a peculiar and interesting nature. With reference to this class of *malarial diseases* we may note the general division which has been made of these disorders into *intermittent fever* and *remittent fever*. A prominent feature of these diseases is their tendency to recur at more or less regular periods. Thus *intermittent fever* (otherwise known as *ague*) is divided into three varieties known as *quotidian ague*, *tertian ague*, and *quartan ague*. These terms are derived from the length of interval between the attacks of the varieties of this disease. The names indicate the liability to the recurrence of the fever at intervals of one, two, or three days.

Of the other, or *remittent*, type of malarial fever, we find what is known as *continued fever* or *jungle fever*, and *hill fever*, this ailment being often termed *remittent ague*. Here we find a continued fever showing remissions or relapses of well marked character, but less sharply separated than the other or intermittent type. In addition to these two main types physicians recognise also a dangerous type of malarious disease peculiar to tropical climates, and known as *pernicious malaria*, whilst another variety of these troubles known as *malarial cachexia* occurs as a result of ague, and is associated with the presence of anæmia or bloodlessness, and another symptom common to most malarial troubles in the shape of an enlarged spleen.

Variations.—With reference to the difference between *intermittent* and *remittent ague*, we find a notable feature in the fact that in the intermittent variety of the disease the temperature in the intervals between the attacks sinks to a normal degree. On the other hand, in the case of the remittent varieties of malarial fever, we may find each day represented by relapses, whilst the temperature during the intervals does not quite fall to the normal Also, here, what is called the cold stage of the fever is of short duration, whilst the hot stage represents a much longer period.

Ague, it need hardly be said, is chiefly characteristic of tropical areas, but even in Europe, in marshy districts, and in some parts of Ireland, ague may be found endemic. In Britain, in swampy districts, ague is also known to occur, but appears to be of a somewhat milder type than that found in tropical regions. Formerly this disease was much more common in Britain and other parts of Europe than it is to-day. Its abolition has no doubt been largely due to the fact that lands formerly uncultivated and of swampy character have been reclaimed by proper drainage, in this way the malarial conditions being naturally abolished. It would appear that clay soils are more favourable to the development of this disease than others, but sanitarians note that even an otherwise healthy soil might become malarious in character through the collection of subsoil water. Possibly, however, there can be no malarial condition induced save under the presence of decaying vegetable matter itself.

Eucalyptus and Malaria.—A curious point has been noted, that the planting of *eucalyptus trees* has been followed by an improvement in the health of malarious districts. The effect of such planting has been supposed to be due to the fact that the malarial poison, or emanation from the soil, does not rise high into the atmosphere, and is destroyed by the resins contained in the leaves of the tree in question. Other authorities, however, doubt very much whether any such disinfection can be effected by the leaves, and in any case where

improvement has apparently followed the planting of eucalyptus trees such an effect has been attributed to the fact that the soil has thereby been rendered of a drier nature.

The Germ.—With reference to the germ or microbe of malarial fever, we find that, as in the case of dysentery, this microbe belongs to the animal world. It is known as a *Hæmatozöon*, and belongs to the protozoa, or lowest division of animal life. This parasite, for such it should be called, undergoes an extremely complicated mode of development. It seems to attack the red corpuscles of the blood, insinuating itself inside the corpuscle and destroying it. The parasite shows us a body consisting of a speck of protoplasm or living matter, which, after attacking the corpuscle, undergoes a certain amount of division. Previous to this it has developed a certain amount of pigment or colouring matter. At a later stage the parasite develops an appearance which has been termed the "rosette form," the pigment or colouring matter lying in the centre of the rose. When this last stage is noted it is seen that each of its divisions represents what is called a *spore*, or body capable of developing into a new parasite. Later the rose breaks up into segments of crescentic shape, which in turn undergo development inside the blood corpuscles, and which will repeat in their history that of the forms whence they were derived.

In this way, as may be imagined, successive crops of these parasites are liable to be developed, and there can be little doubt that each relapse in a case of malarial fever is directly due to the liberation of a fresh crop of spores. Thus in the case of an ordinary daily attack of ague we find the parasite throwing off its new generations every twenty-four hours. In the tertian form of ague, where the attacks occur every second day, forty-eight hours will be consumed in the development of each generation. In the quartan ague seventy-two hours will represent the development period, giving us thus an attack every third day. In some cases of ague-disease it has been found that where a daily attack is represented such a result has been due to the tertian form of the parasite diminishing by one-half its ordinary time for producing new generation. In addition to the forms of the parasites already described, the crescentic forms noted appear to be associated with the development of a special variety of malarial fever characterising the autumn season. This latter variety may show a development of thread-like processes, or *flagella*, similar to those seen in the bacillus of typhoid fever. These *flagella* may separate themselves and appear really to constitute another variety of the spore or young germ.

Insects and Malaria.—The part played by the mosquito in the infection of man by this disease has been very fully worked out

of late years by Ross and others, and there can be little doubt that certain species of these insects serve as the media and active agents whereby human attack occurs. The idea that destruction of these insects would imply the prevention of the disease in question is seen to be founded on a legitimate assumption. The abolition of pools of water wherein the mosquito breeds has been found in many cases to reduce the chances of attack. In practice this work has been carried out in some districts with success, as also has that of destroying these insects by the use of paraffin oil, poured into the pools or shallow water spaces in which they breed. There is no doubt that the mosquito, drawing blood from a malarial patient, becomes itself infected with the parasites of the disease, and it may be mentioned that the development of the spores of the parasite has been seen to take place within the stomach of the insect. This residence in the insect is regarded as a necessary part of the development of the microbe, so that when such development has proceeded to a certain limit the mosquito can infect another human body through its bite conveying the parasites into the blood of the patient. It has been noted on more than one occasion that malarial fever may be conveyed through the medium of drinking water. We can perfectly understand this latter occurrence when we have regard to the fact that water forms the medium in which these germs may breed and multiply.

Ague.—Dealing first with *intermittent fever or true ague* we find that each paroxysm or attack of this fever exhibits a stage of shivering and chill, this being succeeded by a hot stage, the attack ending in profuse sweating. It has already been explained that each variety of the fever is characterised by the different intervals between the attacks.

Physicians are accustomed to speak of the *interval* between an attack as represented by the time between the beginning of one paroxysm and the commencement of its successor. The *intermittent period or intermission* represents the time between the end of one attack and the commencement of the next.

What is known as *tertian ague*, where the attack occurs every forty-eight hours, is perhaps the most common variety seen of this disease in temperate regions at least. The period of incubation appears to vary, but the premonitory symptoms may last only a few days, and are marked by general *malaise* with headache and loss of appetite. In the cold stage which succeeds, and which may last from half-an-hour to four hours, the patient presents all the appearance of suffering from a violent chill. He shivers, his teeth chatters, the skin is pale and exhibits raised points, giving it the appearance popularly known as *goose skin*, whilst the pulse is small, and the patient's appear-

ance at large an extremely miserable one. It is notable that while the temperature of the body would appear to be much reduced, examination made by the clinical thermometer placed in the bowel, shows an actual rise. The quantity of urine passed may be large. It is of pale colour, and its specific gravity low. At the end of this cold stage the temperature may reach even to 103 degrees or to a higher stage.

The hot stage succeeds, this latter lasting from two to four hours. It varies in the suddenness of its onset. Then the skin becomes of a burning hot-character, and a rash may form upon it. Vomiting may be present. There is intense headache, the urine in this stage being scanty, whilst around the mouth "*herpes spots*" or "*cold spots*," similar to those seen in an ordinary cold, may be noted to occur. The sweating stage then comes on. It is marked by the falling of the temperature, and if the forehead be noticed, profuse perspiration may be seen at the roots of the hairs. This perspiration soon becomes general all over the body. It is of a sour-smelling character. The kidneys resume their functions, the pulse falls, and so far the patient appears to obtain ease. In this latter stage the urine is of high specific gravity and throws down urates, which appear as a reddish sediment. It is notable that the spleen grows larger during the attack. In the case of ague becoming of a chronic nature this enlargement may remain as a lasting feature of the patient's condition. It is then known as "*ague-cake*."

In such a case we may find represented the condition known as *malaria cachexia*. This condition has already been mentioned as being associated with *enlarged spleen* and with *anæmia* or *bloodlessness*. This latter symptom may be extremely well marked, and is noted to be caused by an extreme lessening in the number of the red blood corpuscles, a fact no doubt due to the attack made upon them by the malarial parasites. Dropsy may be also present in this trouble, due to the heart's action being impeded, while great breathlessness results from the least exertion and the temperature may be lowered. It may show, when the patient has his bad days so to speak, a rise amounting to 103 degrees.

The Intervals.—In connection with the curious types presented by this disease where a definite interval separates one attack from the other, and during which time the patient appears to be fairly comfortable, we find an explanation of this fact afforded, as has been suggested, by the peculiarities exhibited in the development of the parasites in the blood. It is known that each relapse practically corresponds with the liberation into the blood of a fresh crop of the parasites. The interval will correspond with the practical death of

these intruders, or at least with the cessation of their activity. During this period it is believed that they retire to the spleen as a kind of nursery, in which the development of the fresh generation takes place. It is the liberation of this new crop from the spleen into the blood which may be supposed to correspond with the next attack of the disease. In the case of what is called *pernicious ague* rapid death may occur from extreme collapse, whilst the spleen may be ruptured and the intestine may sometimes undergo perforation.

Treatment and Prevention.—With reference to the preventive treatment of ague it is hardly necessary to point out that extreme attention should be paid to the general health. The boiling or effective filtration of all drinking water is a necessary precaution for those who live in ague districts. It is recommended that persons residing there should take a daily dose of quinine, amounting to eight or ten grains. The clothing should be warm, chills should be avoided, night air being regarded as specially injurious. When an attack begins the patient is to be placed between blankets in bed, whilst hot bottles should be applied to his feet and a hot drink should be given; probably very hot tea may be regarded as an effective application of this latter kind. *During the first stage of the disease* the body may be sponged with tepid or cold water, whilst any cooling drink may be administered.

During the sweating stage naturally the great aim of the treatment is to prevent chill. Tepid drinks may also be administered here.

Drugs.—The great remedy for all malarial fever is of course *quinine.* This valuable remedy practically represents the principle obtained from the bark of the *cinchona tree.* This discovery has been attributed to the Jesuits, who are believed to have been taught its use for the prevention of tropical diseases by the South American Indians.

There can be little doubt that quinine, acting as a specific in ague and in malarial troubles at large, effects this end through its acting as a germ-poison when circulating in the blood, thus killing the microbes to which this ailment are due. With regard to its administration in ague, it is generally agreed that during the intermission (between the end of one attack and the beginning of the next) a fairly large dose of from twenty to twenty-five or thirty grains should be administered; this dose should be repeated at the end of the attack. Thereafter it is usually given in fifteen grain doses at intervals of one, two, three, and four days successively. The further treatment is carried on by giving a moderate dose of say eight to ten grains, it may be for months. By the administration of quinine in this form the development of the parasites is not merely prevented, but in all

probability a decided effect is thus exerted upon those forming the parent organisms of the next generation.

Physicians are accustomed to administer quinine also by injecting it into the skin by what is called the *hypodermic method.* It appears to be a remedy which is very rapidly absorbed by the blood, and to this quality may be ascribed its power of cutting short the disease. Between attacks, arsenic is often administered. The dose of this remedy, given in the form of Fowler's solution, would amount to from five to six minims given in water immediately after food twice or thrice daily. This treatment is believed to effect much good where the ague appears to have departed from its ordinary regular course.

Another Treatment.—An interesting observation connected with the treatment of ague is that which tells us how Dr. Livingstone, the great African traveller, was in the habit of beginning the treatment of all his cases by administering six to eight grains of resin of jalap and of rhubarb, combined with four grains of calomel and four grains of quinine. This treatment was also adopted with success in the case of remittent fever. After the purgative action of this mixture had been attained, quinine was administered in four-grain doses every four hours, until twelve doses were given in the twelve hours succeeding the administration of the purge. If dysentery has been represented in the history of ague patients, it might be added that this treatment should not be practised.

The medicine known by the name of Warburg's Tincture, which contains quinine, is also highly spoken of by physicians who have had much experience of malarial fevers abroad. This treatment produces profound sweating. It is administered after the bowels have been acted upon. Half an ounce of the tincture is given undiluted. All fluids must be withheld from the patient, while a second dose is administered after a three-hours' interval.

With reference to the treatment of *malaria cachexia*, with its bloodlessness and enlarged spleen as its chief features, great care should be taken of the general health. A sea voyage very often acts excellently in this trouble. All danger of cold must be avoided, and a residence at Carlsbad or Homburg, with bath treatment and the taking of the waters, has found favour in the eyes of many physicians.

A tonic is also necessary in this case, a teaspoonful of Easton's Syrup given in water after meals thrice daily being that frequently prescribed. Later on the tincture of perchloride of iron in fifteen-drop doses, given in water after meals, may be tried.

For the enlargement of the spleen the ointment of the red iodide of mercury has been used, along with douching with cold water. The ointment's strength is given as thirteen grains of the mercury to an

ounce of lard. It may be applied after the spleen has been douched with cold water. For each application a piece of the ointment of the size of a walnut is to be well rubbed into the spleen, the patient being laid before a strong fire. A similar application may be made a little later in the same day. If the enlargement still persists, the application may be repeated after a fortnight's interval.

Remittent Fever.—With regard to *remittent fever*, which is more typically a disease of the tropics, this ailment has also been called *jungle or hill fever*, whilst *Bengal fever* and *bilious remittent fever* are also names applied to it in different localities. As already stated here, we meet with an ailment in which the fever is more or less continuous. There is no distinct interval between the attacks. All that can be said is that its force lessens during what may be called the interval period. The average duration of this disease is from ten to fourteen days; the remittent period may be as low as six, or extended to twelve hours or more.

Symptoms.—Here we find headache, depression, and other premonitory symptoms. A cold stage is usually indefinitely marked, but the heat stage is extremely severe with vomiting, high fever, and headache, the patient sometimes wandering in his mind. To this succeeds the sweating stage, and after this latter phase has disappeared the whole round of symptoms begin again. Jaundice may appear in the course of this disease. It is noted in the case of remittent fever that the morning is the usual time for attack, with an increase of its severity at night.

Treatment.—*Quinine* is the remedy here, given in a dose of four or five grains every three hours during the remission. This remedy is not to be administered during the hot stage. Cold may be applied to the head, whilst the body may be sponged with cold water. A purge by way of securing an efficient bowel motion is necessary at the commencement of the treatment. In cases of collapse administer stimulants freely. The tonic treatment already described, as well as removal to a climate free from all malarious influence, are necessary to avoid this disease producing serious effects.

TETANUS OR "LOCK-JAW"

This most serious disease generally appears as the result of some injury. It may also occur without the presence of any definite lesion. This ailment is more common in hot countries than in temperate regions, and it is noted occasionally to appear in an epidemic form. Nothing is known of the specific conditions which produce such

epidemics save that they appear to be accompanied by sudden changes of temperature. The curious fact is that amongst lower animals, horses appear to be specially subject to lock-jaw. This fact may explain the reason why, amongst stablemen and others similarly occupied, lock-jaw frequently occurs.

There is no doubt that lock-jaw arises from the infection of the system in one way or another by the specific germ or *bacillus* of the disease. This germ is found everywhere in the earth and soil around us. It occurs in the mud of streets, and is also found amongst manure and stable refuse. It appears to breed with extreme rapidity, and can grow in the absence of oxygen, which is a medium necessary for the development of many other germs. This bacillus appears to possess powers of movement, and when a spore is developed at the end of its rod-shaped body, it thus assumes a highly characteristic club-shaped appearance. It will be understood that the common mode of infection in this serious trouble is through these germs gaining admission to the body through a wound or break of substance.

Infection.—Lock-jaw is generally associated with wounds which are of a contused character—represented, say, by a crushed toe. Such wounds do not tend to heal rapidly, and are therefore more subject to contamination than in the case of a clean cut, the edges of which are readily brought together so as to promote a ready repair of the injury. The fact that lock-jaw is very frequently found associated with injuries of the toes and lower extremities would seem to point to greater risk of infection in those parts from their near proximity to the ground. Primarily, therefore, the prevention of this disease means the adoption of every method and plan whereby cleanliness of a wound is ensured and freedom from infection attained. Once infected, the germs would appear to remain at first more or less at the seat of the wound. In such a condition they seem to be placed favourably in respect of the absence of oxygen, which we have seen to be unfavourable to their growth. In this situation they produce by their multiplication their particular toxin or poison. It is the passing of this toxin from the seat of the wound through the body, and specially towards the nervous centres, which develops the characteristic features of the disease. A certain interval, or *incubation-period*, elapses between infection of the wound and the attack. This period, on the average, extends to about ten days.

Symptoms.—The first symptoms are found in stiffness of the jaw muscles, and of those of the neck. What is known as "lock-jaw" represents the comparatively fixed condition of jaws preventing movement and swallowing. The other muscles of the body are gradually affected. Indeed, in many cases the muscles of the belly

may be attacked before those of the throat. The later symptoms which succeed are marked by tetanic or spasmodic contractions of the muscles, whereby they remain in a state of more or less permanent contraction. In a severe case the body may be thrown into a veritable arch, one end represented by the patient's head and the other by his heels.

Pain is experienced by the patient, and his skin may burst forth into profuse perspiration. A high temperature is a marked feature of this disease. It has been known to mount up to about 112 degrees shortly before death. These symptoms continue at more or less frequent intervals, the patient's strength being gradually exhausted by the action of the poison on his nervous centres. In from three to five days a fatal result is usually produced, but it is said that if a patient is able to combat the disease for a week, hopes of recovery may be entertained.

Treatment.—It will be understood that in a disease of this kind treatment is of little avail. In many cases the physician administers chloroform during the attacks by way of endeavouring to give the patient some degree of rest. Hypodermic injections (under the skin) of morphia, atropine, or other sedatives are also given the patient. Strength is kept up by administration of nutrient injections by the bowel. The room must be kept dark so as to avoid all sources of irritation. Treatment may also be carried out by means of *chloral*. In some cases the surgeon cuts out the scar of the wound representing the seat of the infection, or a limb might be amputated by way of saving life. These means, however, are usually adopted too late in the day.

Antitoxin Treatment.—It should be mentioned that an *antitoxin* of allied nature to that used in the treatment of diphtheria has been prepared from the germs of this ailment. This antitoxin, as in the case of diphtheria, is contained in the fluid part of the blood of an animal which has been inoculated gradually with the microbes of the disorder. Injections of this antitoxin are made into the patient's blood, and their favourable action depends on the conveyance of this remedy by the blood to the affected nerve-centres. The difficulty of this form of treatment appears to be largely due to the fact that the disease usually obtains a definite hold of the body before the necessity for the administration of the antitoxin has been recognised. In this respect, therefore, lock-jaw is not a disease so easy of treatment by the method in question as is diphtheria.

LEPROSY

What is known as *True Leprosy* is generally recognised by physicians to-day as representing a very much modified form of the general disease known as *tuberculosis* (see page 230), whereof *lupus*, already treated of, is another variety, and *scrofula* in all probability a third. Like lupus, leprosy especially attacks the skin. There are two forms of this disease recognised in medicine. One of these, known as *true leprosy*, is also called *tubercular leprosy;* the other is most frequently known by the germ of the *anæsthetic* type. With regard to the latter variety of the trouble, it may be said that it is chiefly indicated by spots or patches developed on the face and arms. These are of reddish colour around their margin and possess white centres. They grow ultimately into *nodules* or *lumps.* As these parts lose all sense of feeling, the state known as *anæsthesia* is thus represented, this condition giving its name to the trouble.

The progress of this disease is associated with a certain amount of contraction of the skin, the nerves of the parts being attacked. Paralysis is also apt to occur as a sequel of this disease, whilst decay and degeneration of bone are also typical symptoms. It may be added that the progress of this form of leprosy is essentially slow. It is doubtful if any form of treatment can be successfully applied in this ailment.

True Leprosy.—True leprosy is a very different disease, and one which runs a more definite and a more rapid course. This disease is undoubtedly that spoken of in the Bible under its own name, although at the same time it has been noted that the biblical term "leprosy" is one which probably was extended to include other forms of disease not belonging to the category of ailments under consideration. There can be little doubt that leprosy is endemic in certain parts of the world. Thus in India and China it is found, and also in Egypt and Japan. It occurs in the West Indies and also on the west coast of America, extending to the Pacific Islands. Some parts of Africa also exemplify endemic centres. At the Cape of Good Hope it has of late years assumed an undue prominence.

European Developments.—The first appearance of this disease in Europe dates from the commencement of the Christian era, and for nine hundred or a thousand years it appeared to be markedly on the increase. Its disappearance commenced in the sixteenth and seventeenth centuries, and to-day Europe is free from it, with the exception of certain areas in Norway and Sweden and in Finland. In the south of Europe it is also known to occur, Sicily and Cyprus being mentioned as areas in which the disease is represented. As a rule

leprosy areas are situated near the coast, and it may be mentioned that a recent theory of the causation of this ailment attributes it, not to the use of salted fish, as has been sometimes stated, but to the eating of fish which has been allowed to attain a putrefying and decomposed condition. In this view of matters leprosy would be caused through such food serving as a soil for the development of the particular germ or microbe. An objection to this theory has been expressed on the ground that leprosy may be found in inland places where the use of fish of any kind is extremely uncommon. The probability is that more than one cause may be regarded as possible in respect of the special means whereby the germs of the complaint are introduced into the body.

Its Contagiousness.—A similar difference of opinion has existed regarding the *contagious nature of the disease.* Some authorities believe that it can be conveyed by contact with the sick; others that it cannot be so carried, and that where it appears in those associated with lepers infection has taken place by means of the food. It can certainly be inoculated on a healthy person by the use of the secretions found in the leper's skin. It would appear that certain races, exemplified in the case of the Chinese and Hindoos, are more likely to be affected than are white peoples, and the male sex presents a larger number of cases than the female.

Symptoms. — The symptoms of true leprosy are found in a roughened eruption which is developed on the face and afterwards extends to the trunk and limbs. These roughened points or tubercles in time grow softer and suppurate. They then burst or break, and leave ulcerated patches. In time the bones are affected. Where healing of the sores occurs, blotches are left with white scars. It would appear to be a common occurrence in leprosy that the lungs are liable to be affected, although, curiously, the bacillus giving rise to the lung trouble is not that of leprosy but of consumption, or tuberculosis itself. This association would appear, in one sense, to form an argument for the idea that leprosy and tuberculosis are closely allied diseases. It is said that in many cases *the first symptom of leprosy* is found in the shape of a sore or growth affecting the inside of the nose.

Heredity.—With regard to the inheritance of leprosy, this point has been as hotly disputed as has the question of its contagious nature. The question may be regarded as utterly undecided. Authorities, indeed, are equally divided on the question whether the children of lepers are more liable to develop the disease than the children of healthy parents.

Prevention.—With regard to the prevention of this disease, there can be little doubt that the separation of those who are sick from

healthy persons is the first cardinal point demanding attention. We know that in the early days of the Jewish race the law decreeing the segregation of lepers was carried out most rigorously. The leper was thrust outside the camp, and left to his own devices in the way of supporting himself. A more humane treatment of lepers came into vogue by the opening of leper houses or leper hospitals. In Scotland these were early instituted, and in certain localities the existence of these establishments is indicated by the names by which these localities are now known. Thus near Edinburgh, for instance, the village of Liberton derives its name from the words "Leper-town," an establishment for the treatment of lepers having been founded in that place. The example of Norway in the establishment of leper hospitals, with a remarkable diminution of the disease as a result, offers an object-lesson in point. We learn that these hospitals were established in Norway in 1856. The number of cases fell from about three thousand in the year mentioned to a little over a thousand in 1887. At Hawaii, in the South Pacific, we find practically a leper island, where lepers are placed for the whole period of their existence. The duration of true leprosy is said to extend to about sixteen years, although this period is subject to great variation.

Treatment.—The treatment of leprosy, like that of lock-jaw, has, as a rule, presented a rather hopeless subject.

There can be little doubt that great attention must be paid to the general health and to the use of frequent baths, while removal from a leprous district is also a necessity of the treatment. The diet is to be liberal, and must include a fair proportion of animal food, whilst tonics, including iron, quinine, and strychnine, and the administration of cod liver oil, are given as aids in building up a healthy condition of the body.

Drugs.—The list of remedies proposed for the local treatment of leprosy as well as for internal administration is a very long one. These remedies range from arsenic to cauterisation applied to the growths. The oil called *chaulmoogra oil*, obtained from the seed of a tree grown in India, has been administered in doses from six to twelve drops thrice daily, and has also been applied to the sores. Gurjun balsam, or Gurjun wood oil, has also its admirers in the treatment of this disease. This also is obtained from an Indian tree. It is used as an emulsion, equal parts of the oil and lime water being mixed together, the dose being from two to four drachms given twice daily. *Ichthyol*, applied in the form of a strong ointment, has also been employed in the treatment of lepers.

It need hardly be said that careful disinfection of the sores is necessary, and attention must also be paid in this connection to the disinfection of the clothes of the leper.

YAWS, OR FRAMBŒSIA

Under this name a curious disease, no doubt of germ origin, has been described. It seems specially to affect the negro races, and is found both in Africa and the West Indies. It is undoubtedly infectious, and occasionally assumes an epidemic form.

Its characteristic feature is the development on the face, neck, foot, and other parts of the body of small rounded points or tubercles of a dull yellowish colour. These grow together and ultimately form a kind of fungus growth which produces in time a discharge and ulceration, leading to bleeding and frequently resulting in death caused by exhaustion.

The period of incubation here is from three to ten weeks, one attack appearing to protect against another. Its average duration is from two to four months, but it is stated that the period may be extended to one or more years.

The treatment is represented by cleanliness and generous diet.

Carbolic acid is applied to the seat of the disease, while a diluted nitrate of mercury ointment has also been used. Iodide of potash combined with some vegetable infusion has also been administered internally.

SLEEPING SICKNESS, OR NEGRO LETHARGY

Under this name reference must be made to an extremely curious ailment which of late days has been engaging a large amount of attention on the part of medical men who devote themselves to the study of tropical diseases. This affection is constantly present in West Africa, whilst it is common here and there in the district ranging from Senegal to Loanda. It is also described as being frequently met with in the middle district of the Congo, whilst it is also known to be present on the coast and in island districts, Fernando Po and the Isle de Principe exemplifying the latter case. Inland, this sleeping sickness is found to be developed on the Upper Niger, whilst it occurs on the shores bounding Lake Tanganyika. It has been found in Uganda, and is met with in the Upper Nile basin. Outside Africa, it has been noted to occur in Guiana.

Distribution.—Sleeping sickness appears to be confined exclusively to the coloured races. The negro, mulatto, and the Moor appear to be attacked, but as far as is known it does not occur in Europeans, one authority, however, expressing the opinion that if a European should be exposed sufficiently to infection, the disease might

be acquired. One such case indeed has actually been reported. It would appear that all ages and both sexes are liable to attack. When the disease has once appeared in a village it seems to hold tenaciously to the place, and to spread from one house to another. One feature of this ailment is *the long period of incubation* which it exhibits. This period is said in some cases to extend even to seven years, so that cases are known in which a negro, living apparently in a perfectly healthy condition, say in some part of Great Britain, ultimately develops the disease. With regard to the duration of sleeping sickness it is stated that a period of one year probably represents the duration of a case. In some instances, however, a fatal result has been produced by this ailment in three months. In certain cases of a chronic character the duration is set down at about three years. In so far as infection of a personal kind is concerned, it is said that this disease is capable of being communicated through the saliva or secretion of the mouth. The habit of negroes eating their food with their fingers from a common dish may represent one method of the conveyance of this affection.

Its Nature.—The disease is certainly an extremely peculiar one. It is defined by medical men as consisting of a special inflammation of the membranes of the brain and spinal cord, and possibly also of the substance of the spinal cord itself, the chief symptoms developed being the sinking of the patient into a state of lethargy or "coma," represented by the tendency to remain in a half insensible condition, this state gradually leading onwards towards death. The onset may apparently be sudden. The patient is easily tired, whilst he begins to show symptoms of breakdown of his mental powers, his memory being deficient. He falls asleep while at work or at his meals, and this condition of lethargy, as time passes, becomes deepened and exaggerated. His gait alters, and may exhibit a staggering character. He has great difficulty in maintaining the erect posture of the body, even when sitting. Ultimately the case passes from bad to worse, other symptoms appearing in the shape of convulsions, dysentery, diarrhœa, lung troubles, and blood poisoning, the patient practically dying of extreme collapse.

Its Cause.—With reference to the origin of sleeping sickness there can be little doubt that it is caused by the attack of a microbe or micro-organism. This organism probably belongs to the lowest grade of animal life. It is named a *Trypanosome*. The parasite was discovered in 1877 in rats in India. In 1896 Dr. Bruce showed that the so-called "fly disease" of South Africa, an ailment extremely fatal to horses, was caused by their infection with the microbe in question through the agency of a fly. This fly is known as the

Glossina morsitans or "tsetse fly." Dr. Castellani informed Dr. Bruce in March 1903 that a trypanosome had been found in the fluid of the brain and spinal cord in five cases of sleeping sickness. A commission sent out by the Royal Society of London to investigate the cause of sleeping sickness prepared a report on this disease, this report representing the careful work of Dr. Bruce and Dr. Greig. In all cases of sleeping sickness it is now ascertained that the microbe just described is present. The fluid of the nervous system taken from patients not suffering from sleeping sickness was found to be quite free from those parasites, but it is reputed that the microbes can be detected in the blood of negroes living in an infected locality. It is only when the parasites pass to the nervous system that the disease is induced.

The particular fly which appears to infect man is supposed to be the *Glossina palpalis.* In monkeys which have been inoculated with the trypanosomes in question sleeping sickness is produced, and appears in them to run a rapid course. One curious point, having reference to the long period of incubation already noted to occur in this disease, is that the germ or microbe may apparently remain undeveloped in the body for lengthened periods. It has been stated that in some cases in which a person has actually been infected that the parasites may die naturally in the body without producing the disease. This latter event may occur in the dog. A point which will require further elucidation is that concerning the history of the microbe of the disease in so far as its life outside the fly is concerned. Further research, serving to show where it passes the anterior stages of its history, may place the means of prevention within our power, very much as a knowledge of the cause of malarial fever (conveyed by mosquitos to man) has shown that the destruction of those insects is tantamount to ridding a neighbourhood of the ailment.

The *treatment* of sleeping sickness is unfortunately in a very unsatisfactory state at present. No drug appears to exercise any control over this affection. Therefore the sole duty of the physician where cases of sleeping sickness are met with is that of attending as closely as possible to the nutrition of the patient, and in endeavouring to maintain his strength so that if possible the ailment may be thus combated.

END OF VOL. I.

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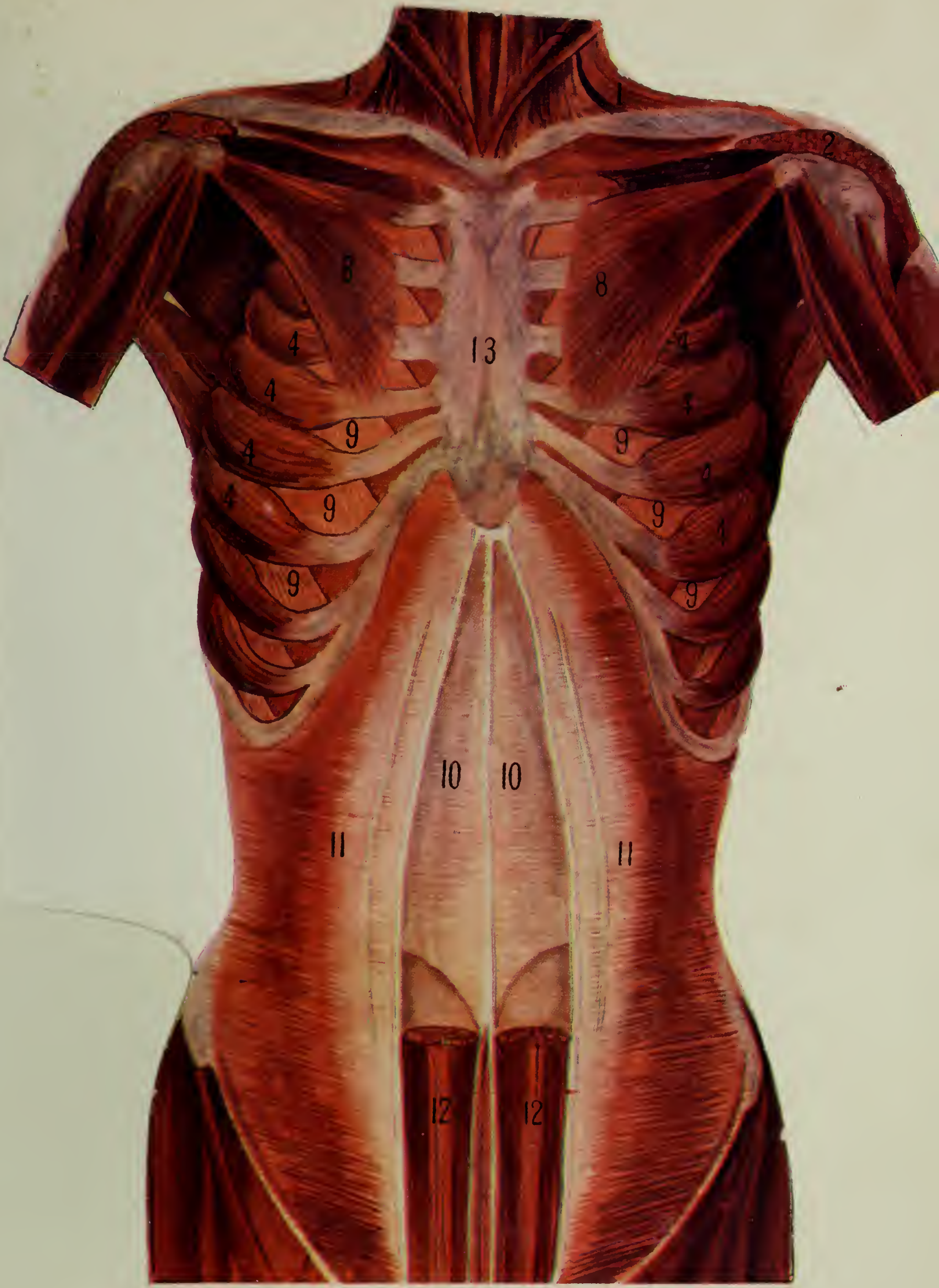
THE SKELETON AND MUSCULAR SYSTEM.

DRAWN FROM ACTUAL DISSECTIONS BY E. BURNET, B.A., London.

1. Trapezius Muscle.
2. Deltoid M.
3. Great Pectoral M.
4. Serratus M.
5. External Oblique Abdominal M.
6. Fibrous Sheath of Rectus M.
7. Sterno-mastoid M.
8. Small Pectoral M.
9. Intercostal M.
10. Fibrous Sheath of Rectus M.
11. Internal Oblique Abdominal M.
12. Rectus M.
13. Sternum.

C. Clavicle.
H. Humerus.
1r—12r. Ribs.
XII. 12th Dorsal Vertebra.
I—V. Lumbar Vertebræ.
S. Sacrum.



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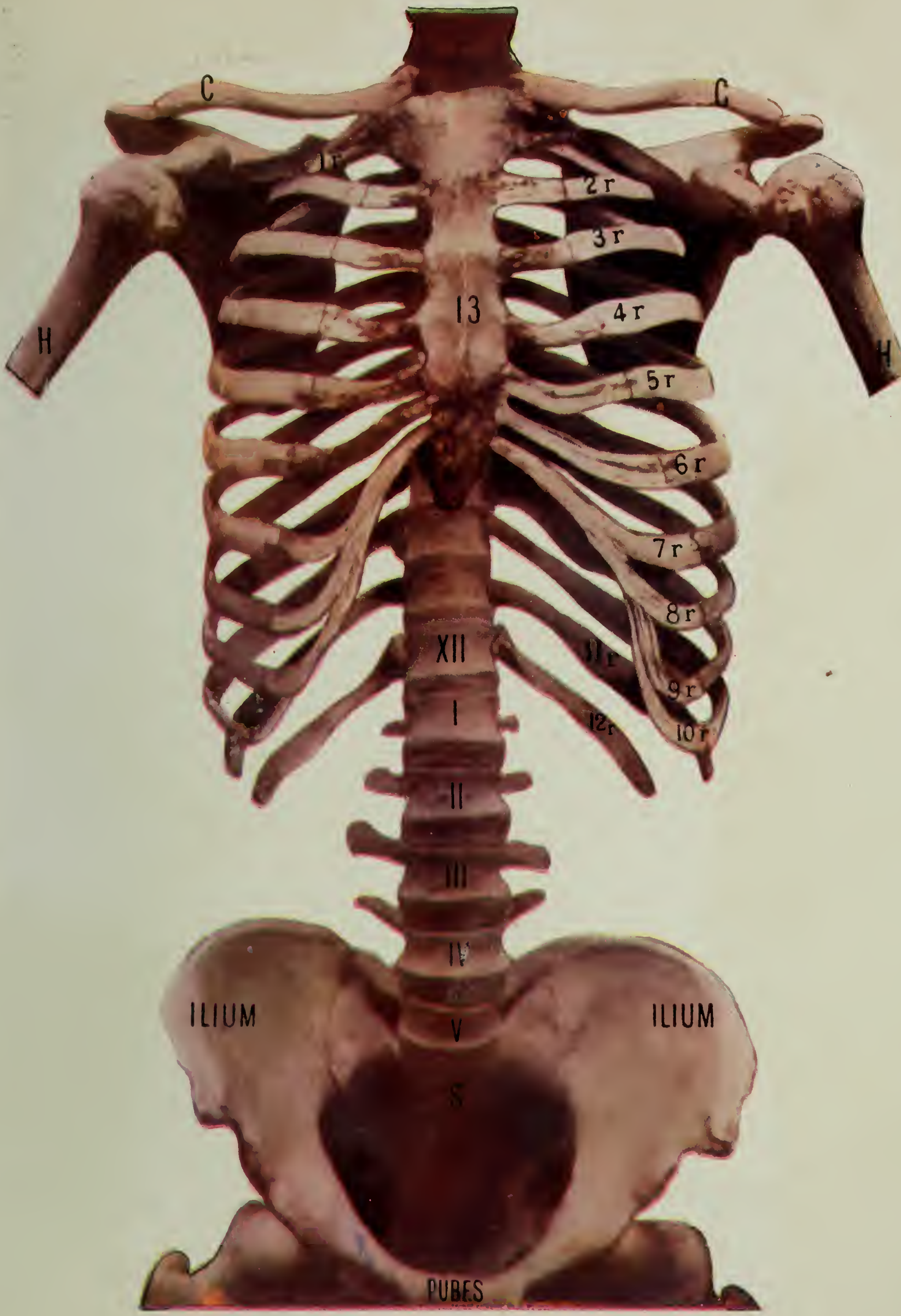

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